KNOWLEDGE
AN
ILLUSTRATED MAGAZINE
OF
SCIENCE, LITERATURE, & ART

LONDON: DECEMBER 1, 1885.

THE UNKNOWABLE;
OR,
THE RELIGION OF SCIENCE.

By Richard A. Proctor.

EVOLUTION OF RELIGION.

The Sun, the Moon, the Stars, the Seas, the hills, and the plains—
Are not these, O Soul, the Vision of Him who reigns?

Is not the Vision He? tho' He be not that which He seems?
Dreams are true while they last, and do we not live in dreams?

Earth, these solid stars, this weight of body and limb,
Are they not sign and symbol of thy division from Him?

Dark is the world to thee; thyself art the reason why;
For is He not all but thou, that hast power to feel "I am I"?

Glory about thee, without thee; and thou fulfillest thy doom,
Making Him broken gleams, and a stifled splendour and gloom.

And the ear of man cannot hear, and the eye of man cannot see,
But if we could see and hear,—this Vision—were it not He?
("The Higher Pantheism") Tennyson.

IF one would mark the precise point where the idea of religion as viewed by the man of science diverges from the idea of the religionist on the one hand and of the opponent of religion (under which I include the Comtist notwithstanding his voice for the religion of Humanity) on the other, one should note it here and thus:—

The theological school regard religion as a communicated gift; the opponent of religion regards religion as belonging only to the earlier and as yet imperfect stages of intellectual development; science recognises an evolution of religion as clearly as she recognises the evolution of mind and thought.

We owe to Herbert Spencer (the first to present fully to the world of thought the doctrine of universal evolution—of which cosmical and biological evolutions are but chapters) the recognition of the oneness of method whereby men in all ages and of every race have formed such religious ideas as have belonged to their time and to their intellectual development. Where the theologian speaks of a time when to some superior kind of man the truth as to God was clearly taught, and recognises a very strong distinction between the manner in which the truly-taught and the majority of falsely-imagining men viewed the great mystery; where the opponent of religion (even when he calls himself a believer in the Religion of Humanity) speaks of the time of theological error, followed by the era of metaphysical suggestion, and by the full development of scientific inquiry, as three strongly-demarked periods of human development; the believer in the doctrine of evolution recognises one process running continuously through the whole history of the development of religion.

The doctrine of biological evolution teaches that man has developed from lower to higher animal types, from the savage to civilised man, from coarseness and brutality to purity and kindliness of conduct, thereby giving us hope for the future, instead of the utter despair which comes from the thought that having originally been created pure and perfect (save for a somewhat imbecile tendency towards disobedience) man has so changed that his heart is now "deceitful above all things and desperately wicked." But the doctrine of religious evolution speaks of better comfort still; tends to save us from a more fatal despair; for it shows men's religions developing ever towards purer and nobler conceptions, until at last all the attributes which savage races assigned to Deity have disappeared. They pictured gods as mighty men-eating chiefs, or as brave but brutal warriors. Later races have imagined one God for their one nation but that God a despot, a man of war, and unreasoning in his wrath—punishing the innocent for the guilty. Later still, advancing races have believed in a Deity who though less despotic and less insensate in anger than the special Deity of some Oriental race, they yet imagine as acting and ruling in a manner scarcely less unreasonable, and in particular as possessing—only on an infinite scale—a spirit of intolerance akin to their own. But as the evolution of religion proceeds, we see all these anthropomorphic and degrading attributes disappearing from men's conceptions of the power working in and through all things, until at length we recognise that those wiser men of old gave the true answer to the question "Canst thou by searching find out God?" when they said "As touching the Almighty we cannot find Him out; lo! these are but a portion of God's Ways; they utter but a whisper of His Glory: the thunder of His Power who can understand?" In this "confession of impotence in the presence of the Mystery of Things," we not only as Herbert Spencer points out, see "Science brought into sympathy with Religion," we see Religion cleared of "all the knots that tangle human creeds, the wounding cords that bind and strain the heart until it bleeds," we find the promise of a purifying power in humanity in regard to conduct, seeing that humanity has thus been able to purify the conception of deity which is at once the index of human character and points the way of human progress. The evolution of the religious sentiment has enabled man to pass beyond the limits which, by presenting as the best and most perfect rule something inferior even to what humanity had already attained, had checked the progress of humanity towards good. The savage cannot advance till he ceases to set his cruel god as the emblem of perfection; the civilised man cannot gain in intellectual and moral development while he worships an unreasoning Deity of ill-developed moral character (the invention of less advanced races) as the Supreme Being: in the recognition that all anthropomorphic attributes must be rejected from our consciousness of deity, lies our sure hope for the advance of humanity to all of which humanity is capable.

BIRTH OF RELIGIOUS IMPRESSIONS.

In the attempt to trace the evolution of religion we meet with difficulties not found in the study of the evolution of the body or of the mind. The body itself contains the record of the ancestral past as surely, though not so obviously, as it contains the records of its own past. We can place our finger on this bone or this muscle, this nerve or this tendon, as telling of the time when the progenitors of the human race were characterised by such

and such peculiarities. Again in the laws of embryonic development we find evidence, requiring indeed to be carefully cross-examined, but full of meaning, as to the past of our race. As regards mental development we have, apart from cerebral evidence, the evidence of material records indicating (very clearly sometimes) the intellectual capacity of our savage progenitors of various times and in various places. All these we have in addition to various forms of evidence common to all three lines of inquiry—physical, mental, and religious. But we have no material records of religious evolution akin to the bodily records of physical evolution. We find occasional indications of religious ideas in the peculiarities of the remains of structures regarded as religious, and also in the manner of burial; but such evidence is far from satisfactory.

We can learn much from such researches as have been made by Messrs. Tylor and Lubbock, and from the researches which Mr. Spencer has superintended. But what would most conduce to correct views,—evidence of the actual infancy of the religious sentiment among the ancestors of the most advanced races of our time, we want. For aught that is certainly known, the beginning of religious evolution in the leading religious races of to-day, though it may have had the same general character as that of races still in their infancy, may have differed as characteristically as the physical and mental qualities of some savage races differ from those of others, and—in all probability—from such qualities in our own human family at the beginning of its career.

Again, we may follow a method akin to that of comparative embryology. We may ask how the religious sentiment begins and how it grows in the child, and so form vague ideas as to the possible past beginning and growth of religion in the childhood of each race. But this is a method which requires to be very cautiously employed. For the child among civilised races is surrounded by influences tending to check the development of innate ideas and to replace these by imparted ideas; and it becomes very difficult to distinguish ideas of one class from those of the other. Besides, certain influences which must have been very potent in their action on the mind of our savage ancestors, have commonly no counterpart in the experience of the child. For instance, the idea of the ghosts of the dead, and of the power they might possess, would occur to a savage race, but would not present itself naturally to the mind of a child whose first nine or ten years were passed without his knowing of death. The thought of death and of its meaning, comes to the child usually when he has already received from grown persons teachings about religion.

Still, I am disposed to gather from my own recollection of my childish ideas about things outside myself and from what I have been able to learn about the recollections of others and about the ideas of those who are still children, that the ghost idea, though undoubtedly belonging to a very early form of religion, does not belong to its actual beginning, as Mr. Spencer thinks. That neither child nor savage ever actually worships natural objects or forces, is as nearly certain as any such matter can well be. Fetishism is never a first form of religious worship, and often belongs to a far advanced stage of religious development. But I believe that a form of animism not at all associated with the idea of the spirits of the dead, long precedes ghost-worship and the idea that natural objects are tenanted by the ghosts of dead persons. The child is moved by the thought that "what wells up in him in the form of consciousness" is present also in all that he can see or hear or feel wherever he instinctively recognises force—whether in the statical or in the dynamical sense, whether shown by fixity and stability, or by movement and energy. Of course, with the growth of knowledge, by which the origin of these forms of force becomes known, the child loses the idea of life and consciousness in things unconscious. But as the farther back we go in our recollection the greater the number of objects which to our child-mind seemed alive and consciously exerting force, I imagine that could we but recall our baby-mind, and read such vague fancies as take the place of thought with the babe, we should find nearly everything he sees suggestive of consciousness to the baby as he first passes the stage when

> ..... new to earth and sky
> What time his tender palm is prest
> Against the circle of the breast,
> [He does not think] that "this is I"?
>
> But as he grows he gathers much,
> And learns the use of "I" and "me,"
> And finds "I am not what I see,
> And other than the things I touch."

In this stage of mental growth, as thus he rounds him "to a separate mind," the child assigns to all he sees that individuality which is his recent discovery in regard to himself. He does not worship natural objects or forces, but he instinctively endows them with life—he loves them, or hates them, dreads, admires, or despises them, as if they were living things.

In this there is evidence if not proof of the vast antiquity of animism, seeing that it is innate. On the contrary we have evidence of the recent origin of the idea of creation, in the circumstance that this thought is *never* found in the child-mind except as a communicated idea. Even as communicated the child resists the admission of the idea, and often, by questions very difficult to answer, troubles the careful parent, anxious to teach him while still young an idea which the most advanced philosopher recognises as full of difficulties.

One may even say that the idea of consciousness, of innate force, which the child, so soon as he has recognised it as true of himself extends instinctively to all he sees or hears or touches, is inconsistent with the idea of creative power to which such consciousness and force are due. The child-mind thinks with Topsy, "'Specks I grow'd," "'specks it grow'd," and so forth. It is only later, when so many objects supposed to be conscious are found to have been made, that the child begins unconsciously to generalise, entertaining the thought that many if not most things have been made. Yet even then as we know from the evidence of deaf-mutes, the idea of creation does not suggest itself. In no single case has even the most intelligent deaf-mute conceived the idea of a power by which all things were made,—an idea which the theologian regards as really innate in the human mind but lost through the fall of man into sin.

There is evidence to show that as it has been with each one of us when we were passing through the childish stage of our lives, so it has been with the child-man. It seems to me that while Mr. Spencer rightly rejects the thought that nature-worship was the first form of the religious idea, while he rightly says that personalisation exists at the very outset, he is not justified by the evidence (overwhelmingly though it avails against the theories of primitive fetishism on the one hand and primitive theism on the other) in assuming that nature-worship was in all cases in the beginning the worship of an indwelling ghost-derived being. Regarding the child's idea of its own consciousness, as corresponding to the idea of the child-man about a human soul, it appears to me probable

on *à priori* grounds and consistent with all the evidence, that the religious sentiment in the savage had its beginning in the ascription of a soul or spirit to all things which seemed to possess force or energy, and that it was only later, when the ghost-theory had already attained some degree of development, that human ghosts or spirits were conceived to reside in natural objects revered or feared, worshipped or propitiated. It was however always something akin to the human soul or spirit which men recognised in natural objects, even as the child attributes something akin to its own newly-recognised consciousness to such objects. This is no "mere metaphysical assumption," as Mr. Harrison asserts, "of men trying to read the ideas of later epochs into the facts of an earlier epoch." It is the only state of religious sentiment which can be regarded as possibly antecedent to the stage of ghost-worship which Mr. Spencer has shown conclusively to be the very earliest of which actual evidence has been (or perhaps can be) gained. The simple worship of natural objects which has been imagined as the actual first stage of religion was almost a simple impossibility, certainly most improbable,—and all the evidence is opposed to the theory. But the belief in spirits animating natural objects, derived from the recognition of his own spirit and the inferred belief that each of his fellows had a spirit, was as natural in the savage, as the attributing of consciousness to the toy which he caresses or punishes is to the young child.

In this stage of the religious sentiment there is no idea of creation, still less of a Supreme Being as Creator and Ruler. Tpăi the Zulu in answer to Mr. Gardner, who asked him if he knew who made and governs the sun as it rises and sets, or the trees as they grow, presented the natural thought of the child-man, "we see them, but cannot tell how they come; we suppose they come of themselves." Nor is there any thought of a life after death. There is in fact only the sense that "that which wells up in the man himself as consciousness" is present in natural objects having apparently innate force and energy. In this sense this beginning of the religious sentiment justifies what I said at the outset,—that in all ages men have viewed religion from the same direction, from the standpoint of the known towards the domain of the unknown. They were impressed then, even as the man of science is impressed now, by the unknowable; for though what was unknown to them is known to us, it was as surely unknowable for them, as the mystery of infinite power is incomprehensible by us. In each case there has been the consciousness of mystery, in neither has there been the power of conceiving the real nature of the mystery; the finite mystery for the child-man and the infinite mystery for the most advanced scientific student of our day, have in like sort, though by no means in like degree, moved man to religious emotion.

It was, however, with the growth of the idea of the soul or spirit in man, co-existing with the body in life, continuing to exist after the body is dead, that formal religion had its origin. Such religious impressions as existed before ancestor-worship began, were but vague fancies. In them we recognise but the embryo of real religious conceptions. No mythology, no system of theology, can be rightly understood, until we have recognised how the systems of nature-worship from which all modern religions sprang (as their ceremonial observances clearly show), had in turn their origin in the worship of the spirits of departed rulers and the propitiation of the spirits of departed enemies.

Just here a thought akin to that on which those had to dwell who explained at first our kinship to the lower animals, our origin from the savage scarce better than the beast of the field and his origin from lowlier ancestors still, should be considered. Whatever opinion the unscientific may form about that particular detail of the Darwinian theory which they suppose to be the Darwinian theory itself, whatever view they may form or imagine they have formed about the descent of civilised from savage races,* they must admit that they were once children, and that the child is father to the man. If they reject with scorn the idea that their forefather the child-man held ideas about religion which seem to us now preposterous, they can hardly have quite forgotten that their original self, their child-father, entertained very strange fancies about religion. They may seem to have forgotten these fancies, but generally some faint recollection of them can be recalled; and if not, their own children will recall their own former fancies. The consideration of these wild fancies of their childhood should prepare them to admit the possibility, if not, as inquiry assures the student of science, the absolute certainty, that our savage forefathers held ideas about religion which we should regard as utterly absurd. As Mr. Spencer says, "from the consciousness of cultured humanity there have so disappeared certain notions natural to the consciousness of uncultured humanity, that it has become almost incredible they should ever have been entertained. But just as it is certain that the absurd beliefs at which parents laugh when displayed in their children were once their own; so it is certain that peoples to whom primitive conceptions seem ridiculous, had forefathers who held these primitive conceptions."

This will appear more particularly when we consider the development of men's earliest and comparatively simple religious impressions.

(To be continued.)

COAL.

By W. Mattieu Williams.

II.—THE DIFFERENT KINDS OF COAL.

THOSE who are devoted to the study of words may like to know that the original signification of the word coal was different from that which is now accepted. In the third edition of the "Encyclopædia Britannica" (1797) the article on coal commences by telling us that "Coal, amongst chemists, signifies any substance containing oil which has been exposed to the fire in closed vessels, so that all its volatile principles are expelled, and that it can sustain a red heat without further decomposition. Coal is commonly solid, black, very dry, and considerably hard. The specific character of perfect coal is its capacity of burning with access of air, while it becomes red hot and sparkles, sometimes with a sensible flame which gives little light, with no smoke or soot capable of blackening white bodies." We are further told that "Coal can never be formed but by the phlogiston of a body which has been in an oily state: hence

* Or the kinship of civilised and lower races of men. I have found that wherever the inferior races of men are well known and understood—as some Indian races in North America, some savage races in Australia, and the negro in the Southern States—the most devout believers in the verbal and literal inspiration of the Bible, reject as utterly (when pressed) the idea that they are akin to these despised races, though if they accept the Bible account they must accept that idea, as the belief that they are akin to apes, which they think the Bible allows them to escape.

it cannot be formed by sulphur, phosphorus, metals, nor by any other substance the phlogiston of which is not in an oily state. Also, every oily matter treated with fire in close vessels furnishes true coal; so that whenever a charry residuum is left we may be certain that the substance employed contained oil. Lastly, the inflammable principle of coal, although it proceeds from oil, certainly is not oil, but pure phlogiston." (Modern scientists who discuss dogmatically the properties of imaginary entities should be warned by the fate of this poor old phlogiston, or fire-ether, and study its philosophical analogy to the luminiferous ether.)

It is evident from this that, less than a century ago, the word "coal" was used among chemists in nearly the same sense as we now use carbon and charcoal. Our ordinary mineral coal was then distinguished as pit-coal, or fossil-coal, just as the French still describe it as *charbon de terre*, the German as *steinkohle*, and the Italians *carbon fossile*. We should remember that we are an exceptional people in our daily and common use of fossil fuel.

The preparation of wood charcoal is in other countries one of the great national industries. Our colliery population is replaced in Italy, for example, by the carbonari, and our "Black Country" by certain valleys into which the trees growing on the mountain are floated down or pitched down wooden slides, are peeled of their bark, their trunks cut up for timber, and their branches made into charcoal for domestic fuel. The methods of using this, and the lessons we may learn therefrom, will be treated when I deal with the sinful waste of coal that here prevails, and its coming consequences.

The fossil fuel used in this country may be divided into three kinds, the ordinary bituminous coal, which forms the bulk of the domestic fuel of England and Scotland; anthracite; and cannel coal. Besides these there are the graphite, referred to in my last, and which I need not further describe, as it is not used as fuel (excepting in the Bessemer converter), and Whitby jet, which is really a very compact and homogeneous cannel coal used for ornaments. A fourth variety of fossil fuel is used on the Continent, but is very little known in this country. This is lignite, wood-coal, or brown coal. I do not include the bituminous shales among coals, and shall treat of them separately.

If ordinary bituminous coal is distilled, *i.e.*, placed in a retort (which may be simply an iron tube or iron bottle with an outlet tube), and this retort is heated, there first rises through the outlet tube vapour of water; presently this vapour is accompanied with smoky vapour, which, when condensed by cooling, is found to be a solution of salts of ammonia, chiefly sulphate, of brown colour. The colour is due to tarry matter. As the heating continues, and the temperature rises towards a red heat, the vapour becomes more smoky and inflammable. If the vapours are cooled, we now have water, ammoniacal compounds, naphtha, and tar, with more or less of non-condensible inflammable gas, similar to that which we commonly burn.

The order of their production is that in which they are above named; they are all given off all the while under red heat; but the first named continually decrease, and the later named go on increasing as the temperature rises.

The proportions of naphtha, tar, and fixed gas vary with the temperature of distillation; the higher the temperature the greater the quantity of gas and the smaller that of the liquid naphtha. At a very high temperature the tar may be decomposed into gas and solid carbon. Therefore, in the commercial distillation of coal, where the main product demanded is permanent gas, as in our ordinary gas-works, a very high temperature is used. In distilling for liquid products the temperature is moderated. To prevent misunderstanding, I should add that though the naphtha and tar are usually described separately, they come over in this first distillation completely mixed as *crude tar*—a treacly, combustible liquid, which, by further distillation, is separable into the thick pitchy matter commercially known as coal-tar, and the limpid, liquid naphtha. By "fractional distillation"—*i.e.*, distilling step by step at gradually-rising temperatures—a number of naphthas having different boiling-points may be obtained.

These volatile inflammable distillates all belong to the chemical class of hydro-carbons, so named from their composition, hydrogen and carbon. The hydro-carbons of coal have also received the general name of bitumen, from their resemblance, when crude, to mineral bitumen. Hence the coal which contains them in notable proportion is called bituminous coal.

When these are driven off there remains behind in the retort the well-known substance, gas-coke or "fixed carbon." This, however, is not pure carbon, as is easily proved by burning it carefully. Pure carbon burns away entirely, combines with oxygen, and forms carbonic acid gas. If the coke is burned, an incombustible portion remains. This is mineral matter varying in composition with different varieties of coal. (The hard carbonaceous crust that lines the gas-retorts will be described hereafter.)

By the simple processes above described we separate the coal into three chief constituents: volatile matter, fixed carbon, and ash. It is customary to state the proportions of these in describing commercially the composition of different seams of coal. Regarded merely as fuel, this information, added to the physical properties of hardness, density, &c., are usually sufficient, but for some metallurgical uses of coal and coke further particulars concerning the quantity of sulphur (of which there is always more or less) and the constituents of the ash are necessary. To the gas-maker and others engaged in the distillation of coal a statement of the nitrogen contained in the coal is important, as upon this depends the quantity of ammonia he will obtain in the form of saleable salt, which is now an important bye-product.

I shall have to return to this subject of composition of coal again, but need not now go further into details, my present object being to render intelligible the fundamental differences between the different classes of coal. This is desirable, as I find that very few people have anything like clear ideas on this subject. The difference between ordinary bituminous coal, cannel coal, and anthracite is a mystery to most Englishmen.

Anthracite is easily understood. It is a natural coke. It differs from both bituminous coal and cannel in the absence of the volatile hydro-carbons that may be removed artificially in the manner above described. I have given some attention to the subject, and am quite satisfied with the simple explanation which attributes its formation to a natural distillation or roasting of one or the other of these flaming coals. According to this, an anthracite seam is a coal-seam that has been subjected to subterranean heat, and simultaneously to the pressure of the superincumbent rocks. We can produce artificial anthracite by distilling coal and compressing it artificially.

Anthracite differs from artificial coke only in its density or compactness, *i.e.*, the absence of that porosity which in artificial coke is due to the outflowing of the

bituminous matter, leaving these vacancies. It burns as coke burns, allowing for the difference of physical structure; a little flame is given off, but this flame is (in perfect anthracite as in completely coked coke) not a hydro-carbon, bright, sooty flame, but the pale-blue lambent flame of carbonic oxide gas, in the course of its further combustion, *i.e.*, a gas consisting of one equivalent of carbon, combined with one of oxygen, taking up an additional equivalent of oxygen, represented in chemical symbols as $CO+O$ becoming CO_2.

Most of my readers are familiar with the physical characters of anthracite: its hardness, its lustrous blackness, and the fact that, when free from dust, it does not stain the fingers as ordinary bituminous coal does. This is due to its compact and homogeneous structure, as well as to its hardness. Common coal is a medley of laminæ, or layers of vegetable material, of different degrees of hardness and varying structure, some portions being friable to the touch of the fingers.

It should be observed that no broad natural line can be drawn between bituminous coal and anthracite. Soft bituminous caking coal contains as much as 35 or 36 per cent. of volatile hydro-carbons. This is the case, or rather was the case, with the famous "Wallsend coal," now practically exhausted. Other seams of bituminous coal similarly rich in the bitumen constituents exist. They are usually soft, and become semi-fused or pasty when heated, throwing out jets of gas, which push before them the pasty coal in rounded projecting craters, and leaving a very porous coke. I once had considerable trouble in making an experimental distillation of a ten-ton sample of a remarkable coal of this sort from the neighbourhood of Ruabon, and known there as the "Wall and bench" seam. My retorts, specially constructed for obtaining liquid products from cannel and shale, were long iron chambers, with doors at both ends. The coal was charged in trays that entered at the cooler end, and were pushed forwards down the sloping chamber to the hottest or firing end, and there withdrawn on to trollies, one out at this end, and one in at the other. The "Wall and bench" coal swelled like bakers' dough, and jammed all the trays so firmly, that their release was a serious business.

My own analysis of twelve different kinds of ordinary medium or rather hard coals used at the Atlas Iron Works, Sheffield, and from as many different collieries in the neighbourhood, show a range from 24 per cent. ("Staveley Hard") to 29 per cent. ("Stone's Soft"), and an average of 26·2 per cent. and an average of 4·27 per cent. of water and ammonia in addition.

From such coal as this there is decline, without break, to the hard coals of South Wales, used in the iron-works, containing but 20 per cent. and thereabouts of hydro-carbons. In this district a very interesting and instructive gradation occurs. On the eastern extremity of the seam the coal is bituminous, fairly rich in hydro-carbons; proceeding westwards it becomes the harder and semi-bituminous "steam coal"; onward and westward it proceeds with diminishing volatile constituents until it becomes true anthracite. The same gradation has been observed in the coal-seams of the Alleghany Mountains of North America; in the great Russian coal-field lying between the Dnieper and the Don, north of the Sea of Azof, which has an area of about 11,000 square miles; and in other places.

The difference between cannel coal and ordinary bituminous coal is by no means so simple or so easily explained as that between anthracite and bituminous coal. Some of the cannels contain more volatile matter than the softest of the soft bituminous coal, but are nevertheless very hard. Besides this, the composition of their inflammable volatile constituents is different. They are hydro-carbons, but belong to quite a different series, with different properties as illuminants. The subject is interesting, and has not received the attention it deserves. I will discuss it in my next.

THE STORY OF CREATION.

A PLAIN ACCOUNT OF EVOLUTION.

By Edward Clodd.

II.—The Stuff of which the Universe is made up.

THE Universe is made up of *Matter*, *Force*, and *Energy*.

I. *Matter*, under which term is comprised all substances that occupy space and affect the senses, is manifest in three states, solid, liquid, and gaseous. It is probably also present throughout the universe in the highly tenuous form called ether.

Between the above three states there is no absolute break, matter assuming any one of them according to the relative strength of the forces which bind and of the energies which loosen the component parts of bodies; in other words, according to the temperature or pressure; *e.g.*, water becomes solid when its latent heat or contained motion is dissipated, and gaseous to invisibility when its particles are driven asunder by heat.

Since the ultimate nature of matter remains unknown and unknowable, we can only infer what it *is* by learning what it *does*. The actions of bodies, whatever their states, are explicable only on the assumption that they are made up of infinitely small particles which, in their combined state as mechanical units, are called molecules; and in their free state, as chemical units, are called atoms, or elementary bodies. The molecule, which is a compound body reduced to a limit that cannot be passed without altering its nature, can be divided; the atom cannot, whence its name (Greek *atomos*, indivisible). *E.g.*, common salt, the chemical name of which is chloride of sodium, has its molecule made up of the combined atoms chlorine and sodium; water is made up of atoms of hydrogen and oxygen; plants and animals mainly of atoms of carbon, oxygen, hydrogen, and nitrogen.

The atoms or elementary substances number, so far as is known at present, about seventy, but many of them are extremely rare, and exist in such minute quantities as to be familiar only to the chemist. Perhaps we may one day find that the larger number are compounds, perhaps that there is *one* element; but the labours of many years have as yet brought us no nearer their decomposition. They are the raw stuff of which the universe is built, and however much they may vary in their distribution and their combinations, each one is unchangeable in its properties, and withal indestructible. It matters not into how many myriad substances—animal, plant, or mineral—an atom of oxygen may have entered, neither what isolation it has undergone; bond or free, it retains its own qualities. It matters not how many millions of years have elapsed during these changes, age cannot wither or weaken it; amidst all the fierce play of the mighty forces to which it has been subjected, it remains unbroken and unworn—to it we may apply the ancient words, "the things which are not seen are eternal."

XUM

The elements seldom occur in the free state, nearly all bodies being compound, or formed by the union of two or more — rarely exceeding four — elements. Oxygen, which is the most abundant and important of all, and, when uncombined, a tasteless and invisible gas, enters into nearly one-half of the crust of the globe; while of such limited variety of stuff is the infinite complexity of things in earth and heaven produced, that the mass of matter in the universe, as the spectroscopic analysis of light radiated from the heavenly bodies shows, is made up of about fourteen elements.

Our knowledge of molecules, still more of atoms, is yet in its infancy, and it would seem that particles which are beyond the range of our most powerful microscopes to reveal may be as astoundingly complex as the giant orbs of the heavens—nay, as the universe itself. Many ingenious experiments and calculations have been made to arrive at their size and structure, but they leave the problem of the ultimate divisibility or indivisibility of matter where they found it. The seven-hundredth millionth part of an inch is considerably under the thickness to which, if it could be done, a plate of zinc or of copper could be reduced without making it cease to be zinc or copper as we know and handle them. The ovum of mammals, which averages about the hundred-and-fiftieth of an inch in diameter, probably contains not less than five thousand billions of molecules. But, as showing how approximate only such estimates are, we are, in using the highest optical aid we can command, about as far from a knowledge of the ultimate structure of organic bodies as we should be of the contents of a newspaper seen with the naked eye one-third of a mile off. The only hint of a possible limit having been reached in the elements is in the invariableness of the weights in which they combine with each other. Each atom has its own fixed weight; and unites in never-varying proportions with other atoms to form molecules whose properties are unlike those possessed by the uncombined atoms; *e.g.*, oxygen in its simple state is the source of combustion, but united with hydrogen it forms water, which extinguishes combustion. Whether we take water in large or small quantities, from the clouds, or from the ocean, or from the fluids of living things, and decompose or break up its molecules, they will always be found to contain 16 parts by weight of oxygen to 2 parts by weight of hydrogen; whether we take salt from the sea or from the blood of animals, its molecules always consist of fixed proportions of chlorine and sodium, 35½ parts of the one and 23 of the other; in each and every case any excess of either element remains uncombined—left out in the cold for want of a partner.

We have now arrived at a point when the grounds for the assumptions already made—and there are others to follow,—concerning the nature of matter throughout space, whether in masses large or small, in molecules, atoms, and the tenuous ether must be stated, lest confusion arise in the mind.

If atoms are unchangeable in their properties, and changeable only in their relations through combination with other atoms, and in their distribution in space, it follows that all changes are due to motion.

Motion throughout the universe is produced or destroyed, quickened or retarded, increased or lessened, by two indestructible Powers of opposite nature to each other—Force and Energy. Each of these is a convenient term for unknown ultimate causes of certain phenomena of motion and relations between motions, but there are fundamental differences between them which require explanation to prevent confusion in thought.*

II. *Force* is that which produces or quickens motions binding together two or more particles of matter having weight, and which retards or resists motions tending to separate such particles.

When this force acts between visible masses of matter, large or small, distant or near, it is called *Gravitation*; when it acts between the invisible molecules composing masses, it is called molecular attraction, or *Cohesion*; when it acts between the elementary substances or atoms uniting them chemically into molecules, it is called chemical attraction, or *Affinity*.

As this Force inheres in, and can never be taken from, ponderable matter, every atom possesses the tendency to attract, and—in the absence of any opposing Energy sufficient to overcome such tendency — the power to attract every other atom, as well as to resist any separating power or counteracting Energy. The sum total of this Force is constant, and its several qualities are grouped under one doctrine, called the Persistence of Force.

III. *Energy* is that which produces or quickens motions separating, and which resists or retards motions binding together, two or more particles of matter or *of the ethereal medium*. The importance of these words in italics will appear later on.

The sum total of Energy in the universe is a fixed quantity, but it is not, like Force, bound up with matter so that it cannot be transferred. It exists whether it acts or not, and therefore can be stored up.

Energy is of two kinds, active and passive, or, in the terms of science, kinetic and potential. *E.g.*, dealing with masses only, potential energy is seen in a stone lying on a roof or on a mountain, in a clock wound up but not going, in a bed of coal, in gunpowder. Kinetic energy is seen in the stone falling, the clock going, the coal burning, the powder exploding. Not only does the potential pass into the kinetic and *vice versâ*, but the several forms of kinetic energy pass into one another —motion into heat, heat into electricity, electricity into heat and light and chemical action, a definite amount of any one form of energy passing into an equivalent amount of the other, the one disappearing as the other appears. And the tendency of all passive energy is to be converted into active energy until a dead or uniform level is reached, as in bodies of the same temperature wherein no differences of separating power remain. The significance of this will be more apparent when the ultimate destiny of the universe is considered.

The qualities of convertibity and indestructibility are grouped under one doctrine, called the Conservation of Energy.

The Persistence of Force and the Conservation of Energy may be grouped together under the doctrine of the Indestructibility of Power.

Force is the attracting power; Energy is the repelling power; and by the antagonism of these the work of the universe is performed. Every mass pulls every other mass by the force of gravitation—the earth the moon, the sun the earth, some other star the sun, and *vice*

* If the readers of KNOWLEDGE find their conception of cosmic relations made clearer by this paper, their thanks are due to Mr. Grant Allen, not to me. His interest in this effort of mine has taken the generous form of lending me his unpublished notes on this subject, and these are so important and satisfactory a contribution to theories of the dynamics of the universe that it is to be hoped Mr. Allen will speedily give us a book that I venture to think will correct and supplement the current manuals, none of which are altogether free from confusion in statements of the relations between Force and Energy.

versâ. And the moon would fall to the earth, as also the earth to the sun, but that the energy of their orbital motion overcomes the force. When a loaded waggon is pulled, especially uphill, the muscular power which, in the form of kinetic energy, is expended by the horse, overcomes the attractive power inherent in the earth to draw the waggon towards its centre and keep it there. When the energy of heat which drives asunder the particles of bodies, changing them from the solid to the liquid or gaseous form, is expended, then the particles resume the solid form in virtue of the attractive force of cohesion.

If Force had unresisted play, all the atoms in the universe would gravitate to a common centre, and ultimately form a perfect sphere in which no life would exist, and in which no work would be done. If Energy had unresisted play, the atoms in the universe would be driven asunder and remain for ever separated, with the like result of changeless powerlessness, as in the case of force alone. But with these two Powers in conflict, like the Ahriman and Ormuzd of the old Persian religion, the universe is the theatre of ceaseless re-distributions of its contents, whether in the sweep of the stars and their attendant systems through space, or in the pendulum-like vibrations of the invisible particles of every body, or in the throbs of the ethereal medium. So rapid are the motions, the rebounds between each molecule in hydrogen gas numbering seventeen thousand millions per second, that even if the molecules were within microscopic range we could not see them; and yet these collisions themselves are few compared with the oscillations of light waves, which number hundreds of millions of millions in the same time.

Such action shows that, just as there are spaces or distances between the stars measureless in their vastness, so there are pores or spaces between the molecules of bodies, and between the atoms which compose the molecules, measureless in their minuteness. And, if added proofs of these inter-molecular spaces were needed, we find them in the contraction and expansion of bodies through the quickened or retarded vibrations due to the separating energy manifest as heat; in the compressibility, although slight, of liquids; in the liquefaction of the so-called permanent gases, oxygen, hydrogen, and nitrogen under extreme cold and pressure; in the partial solidification of hydrogen, the lightest body known, so that it falls on the floor with the rattling noise of hail.

But more than this. These pores between invisible particles; these spaces between star and star, spaces so vast that the diameter of the earth's orbit, one hundred and eighty-eight millions of miles, seen from the nearest star, is but a pin's point, are not vacant. Speaking of the force of gravitation, Newton said that to conceive of one body acting upon another through a vacuum, is so great an absurdity that no man who had "in philosophical matters a competent faculty of thinking" could ever fall into it.

And the like applies to the transmission of light, heat, and other forms of energy between bodies far and near. For the explanation of these varied, and yet related, phenomena, it is a necessary assumption that the minutest intervals between atoms, as well as the awful spaces of the universe, are filled with a highly-rarified, elastic medium called ether, which, ever tremulous with unentangled vibrations, is the vehicle of energy, alike from the infinitely great and the infinitely small.

That matter should be unseen and unfelt is no new conception to us. Its existence in an ultra-gaseous state, as proven by the action of molecules in tubes where as high a vacuum as seems possible is obtained; its invisibility in air—the vehicle of sound—in steam, and in substances vaporised by the voltaic arc; its extreme rarefaction in such bodies as comets, the stuff of whose tails, spreading across millions of miles, could be compressed into a small vessel, prepare us to conceive unseen realities. Thus, where the sensory organs are powerless to report the facts, science, excluding no faculty from wholesome exercise, bids Imagination use her larger insight to make clear the significance of the things which eye hath not seen nor ear heard.

The value of the foregoing exposition, in itself little more than an abstract, of the relations between Matter and Power, will be proved or disproved in the degree in which it squares with the phenomena to be described and accounted for in subsequent chapters. Meanwhile, the subjoined tabular summary may set the subject in a clearer light.

MATTER. POWER.

	FORCE.	ENERGY.	
		POTENTIAL, OR PASSIVE.	KINETIC, OR ACTIVE.*
Masses	Attraction between Masses, or Gravitation	Separation of Masses (commonly called Visible Energy of Position) Ex. Stone on a roof A head of water	Motion of Masses Ex. Moon's motion round the earth Stone falling Water falling
Molecules...	Attraction between Molecules, or Cohesion	Separation of Molecules Ex. Steam	Motion of Molecules Ex. Steam condensing into liquid Heat-vibrating particles of a poker
Atoms	Attraction between Atoms, or Chemical Affinity	Separation of Atoms Ex. Atoms in a free state	Motion of Atoms Ex. Atoms rushing to form molecules
†Electrical Units	Electrical Affinity	Separation of Positive and Negative Electrical Units Ex. A thundercloud and the earth	Motion of Electrical Units Ex. Electric current
Ether (?) ...	(No evidence of aggregating power inhering in it.)		(All Kinetic Energy, except the small proportion intercepted by bodies in space, passes from matter to the ethereal medium. This is the doctrine of the Dissipation of Energy)

* Each kind of Kinetic Energy has separative, combining, and continuous or neutral motion. Example of Separative—a stone thrown upwards; example of Combining—a stone falling; example of Neutral—a top spinning in the same place.

† This concept of electrical units, which may be the equivalent of polarity of the atom, is here added merely as a convenient mode of envisaging a certain order of phenomena.

THE NEW STAR IN ANDROMEDA.

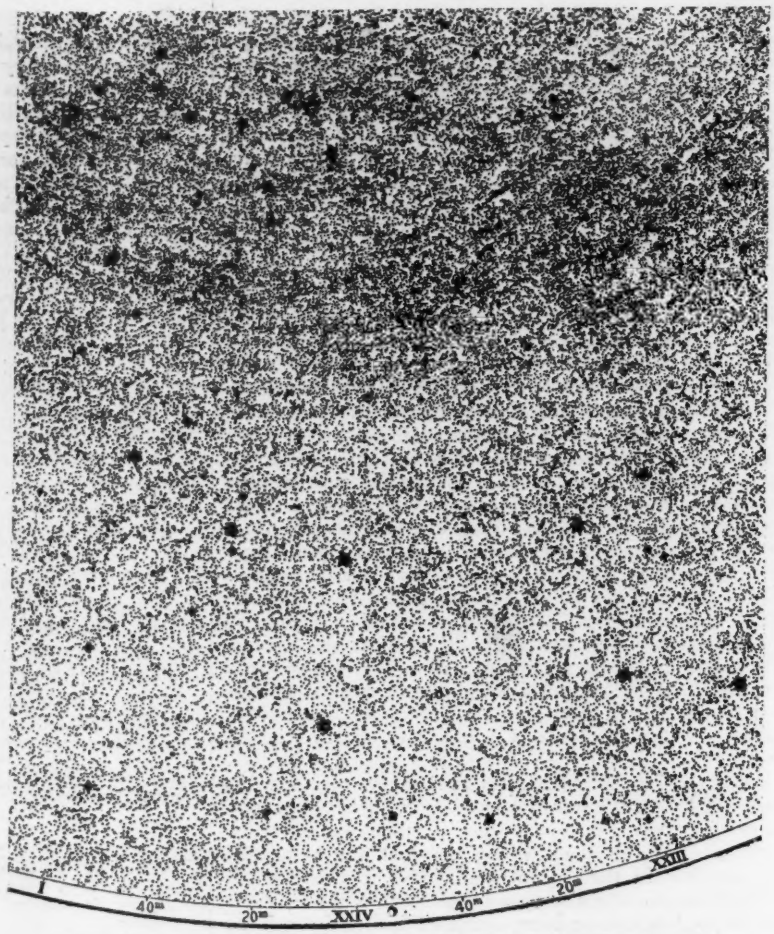
BY RICHARD A. PROCTOR.

A STAR recently made its appearance in the very heart of the most remarkable star-cloud in the heavens. It appeared not far from the spot where some looked for the return (the sixth triennial return as they believed) of the "Star of Bethlehem." I propose here, briefly to consider the import of this strange phenomenon.

In the days before the telescope, astronomers reckoned among the heavenly bodies five star-clouds,—the Pleiades in the Bull, Præsepe or the Beehive in the Crab, the cluster in the sword-hand of Perseus, the nebulous patch around the sword of Orion, and a faint streak of light just outside the northern edge of the waist of Andromeda. Of these, the two last only are what we should now call nebulæ,—but nebulæ of two distinct kinds. How with the invention of the telescope the number of nebulæ increased is related in books of astronomy. Late in the

eighteenth century Messier published a list of 103. Then began the work of William Herschel, who swept the northern heavens with his great gauging telescope, sending in to the Royal Society two lists of a thousand each, and then a supplementary list of 500. John Herschel followed in the same work. First surveying the northern hemisphere to accustom himself to the methods of observation followed by his father, he then went to the Cape, and there completed the survey of the whole star-sphere. Over 4,400 star-clouds were discovered by these two great astronomers,—the total number now known being about 5,000.

The grand idea was thrown out, first, I believe, by Wright, of Durham, that these star-clouds are external galaxies like the system of stars of which our sun is a member. Sir William Herschel early adopted this view. But he also early modified it in a way which few readers of his papers seem to have noticed. For he recognised many of the star-clouds as parts of our own galaxy, broken up in long-past æons. Then later, he noted a distinction between the various orders of nebulæ, which led him to separate one large class as probably not star-clouds at all, but rather great masses of self-luminous vapour. Still he retained even to the last the belief that among the nebulæ are some which really are external galaxies. Sir John Herschel, while recognising strong evidence against this belief, definitely pointing out indeed the most striking fact of all those which oppose the doctrine, retained it as a possible hypothesis, and even noted those among the star-clouds which seem to resemble our own galaxy most closely.



Section from my Chart of 324,198 Stars, showing where the New Star appeared.
(For Key, see Opposite Page.)

Mr. Herbert Spencer was the first to show that the doctrine of external galaxies—at any rate, as that doctrine had been propounded by Arago, Humboldt, and some others—is inconsistent with observed facts. In particular, he called attention to two very striking objections, one indeed fatal, the other presenting very strong probabilities against the theory that the nebulæ are external to our system.

Sir W. Herschel found, late in his career as an observer, that even his most powerful telescopes would not fathom the profundities of some parts of the Milky Way. With each increase of telescopic power more and more stars came into view; but also new areas of nebulous light appeared, which only higher powers could resolve into stars. Of those depths, Herschel said that they were (for his telescopes at any rate) "altogether unfathomable." If then regions within the bounds of our stellar system, are unfathomable, so that the stars composing them cannot be individually seen, how utterly impossible must it be for the same telescope to resolve into stars, or even bring into view, galaxies lying far beyond our own? If for instance the nebula in Andromeda, which just now attracts so much attention, is an external galaxy, then its apparent size shows that it must lie at a distance about three hundred times greater than its own greatest diameter. The unfathomable parts of our galaxy lie less than half its diameter from us. If then the Andromeda nebula is of the same size as our galaxy, it lies about 200 times farther away than those regions which Herschel's most powerful telescope refused to resolve, and failed in part even to see. This of course leads to an obvious absurdity. But if, on the other hand, the Andromeda nebula is no farther off than the parts of our galaxy to which Herschel's telescope reached, then it is necessarily an object very different from our galaxy, having less than the 200th part of its diameter, and less than the 8,000,000th part of its spatial extent: moreover lying at that small distance it must be regarded as belonging to the same region of space, and therefore to the same system.

The other argument, rightly understood, is almost equally convincing. Whenever Sir W. Herschel found he was approaching regions where stars were few,—poverty-stricken regions—he used to call to his sister, Caroline Herschel, who acted as his assistant, "Prepare to write: nebulæ are approaching." He recognised that nebulæ occupy spaces where stars are wanting. This agreement can be no mere chance. Necessarily then the

Key to the Map of Many Stars given on opposite side.

The Great Nebula in Andromeda.

XUM

nebulæ are part of our galactic system. One may compare the case to what might be observed by any one looking at our solar system from some vast distance, but with power to see its smallest individual components. Such an observer would find the asteroids numerous between the regions where the two families of planets—the giant planets and the terrestrial planets—pursue their separate careers. If he failed to notice how precisely the ring of asteroids appeared to occupy the mid-zone between these planetary families, he might very well fall into the mistake of supposing that the ring of asteroids was a remoter family of planets, severally having (on the average) as great a bulk as the terrestrial planets, or even as their giant brethren. Nay we can imagine him falling into a more complicated mistake, and setting the terrestrial planets farther away than the giant planets, and the asteroidal family much farther away still. But if, continuing his observations, he noted the exact agreement of the asteroidal zone with the space where separate large planets were not travelling, and if further he had some idea of the laws of probabilities, he would at once assign to the asteroids their true position as parts of the planetary system. So, as Mr. Spencer long since pointed out,* we must unhesitatingly regard the nebulæ as parts of that system to which the separate stars belong with whose groupings their own so exactly fit.

But precisely as the leaves and branches of a tree occupy different regions, if we consider the tree in detail, while they occupy the same region if we regard the tree as a whole, so, if there were any part of our galaxy so separate from the rest that we could view it from outside, we might expect to find stars and star-clouds intermixed within it. It so chances that there are two such regions, the Greater and Less Magellanic Clouds. In these we find stars of all orders from the seventh down to irresolvable stellar nebulosity,—just as we should in the richer regions of the Milky Way, if these were removed so far away that the brightest stars in them were reduced to the seventh magnitude. And precisely as that would bring the star-clouds (now, from our inner standpoint, seen away from the galaxy) into the same field of view with its streams and branches, so do we find the Magellanic Clouds containing all orders of nebulæ.

While then I would regard the more diffuse parts of the Milky Way as belonging to portions of our stellar system in the midst of which our solar system lies, and the better defined parts in the southern heavens as portions farther away, I regard the Magellanic Clouds as portions much farther away still.

So much I have long maintained. But now the appearance of a new star in the great Andromeda Nebula emphasises the evidence already sufficient to show the general nature of our galaxy. On May 9th, 1860, before astronomers had begun to study nebulæ and stars with the spectroscope, a star of the seventh magnitude shone out in the midst of a nebula in the Scorpion, or rather in place of it, for while the star was shining the nebula was unseen. As the star faded away the nebula (80 Messier, almost midway between α and β) *a star-cluster*, one of those referred to by Sir John Herschel in his letter to me (see last number) resumed its normal appearance. In 1873, a star appeared in the midst of a *planetary nebula*—before unknown—in Cygnus; and again as the star died out the nebula became visible. In the great Argo Nebula a star nominally of the seventh magnitude shone out as a star of the first magnitude, and then faded out of view, the nebula becoming apparently more conspicuous as the star faded. Of all the so-called new stars which have been observed since the matter could be tested, only one, the new star in the Northern Crown, was not associated with any recognisable nebula. So again every new star, except the last-mentioned, has appeared close by the Milky Way, and generally on its borders—and even the star in the Northern Crown lies in a region towards which milky star-streams extend.

This being so, I imagine no one with any power of forming a philosophic opinion, doubted the physical association between the new star in Andromeda, and the marvellous nebula in whose midst it has appeared. Even those who thus doubted, had their doubts removed,—at least I should imagine so (speaking always of persons possessing reasoning power) when it was found that in the main the spectrum of the new star was the same as the highly-characteristic spectrum of the nebula. (There was no fear of confounding the two spectra together.)

This being so we have every reason for inferring that the new star appeared in a part of the galaxy which is probably the nearest to our solar system. In this part from Orion to Cepheus, the five nebulæ visible to the naked eye are all found. Two are shown in the illustrative maps, and these objects are probably as near to us as the lucid stars are (*i.e.* those visible to the eye), on the average, if not nearer.

The picture of the Andromeda Nebula is from the view made with the Harvard telescope by Trouvelot. The new star is not quite central, but it is in the very heart of the nuclear region of the nebula.

* In 1869 in my "New Theory of the Universe" I pointed to the same evidence, not knowing that Mr. Spencer had earlier called attention to it. This I mention, partly for the purpose of handing over to the proper person such credit as may be due for the recognition of the force of this piece of evidence, partly to show that the force of the evidence once noted is unmistakable.

AS a memorial to the late Sir Titus Salt, and in recognition of his benefactions to Saltaire, the Governors of the Salt Schools have decided to build a new Science and Art School, costing about £6,000. The building will be completely finished by May 15, on which day will be opened an important Exhibition on the lines of the late International Inventions Exhibition.

"No one," says Buckle, "can have a firm grasp of any science, if, by confining himself to it, he shuts out the light of analogy. He may, no doubt, work at the details of his subject; he may be useful in adding to its facts; he will never be able to add to its philosophy. For the philosophy of every department depends on its connection with other departments, and must therefore be sought at their points of contact. It must be looked for in the place where they touch and coalesce—it lies, not in the centre of each science, but on the confines and margin."

MODERATE DRINKING.—It is high time, says the *Lancet*, to define what moderate drinking is not. It is not drinking in public-houses; it is not drinking on the sly; it is not drinking early in the day; it is not drinking by itself at other than meal-times; it is not drinking to procure sleep or to relieve pain. All men, and especially all women, who do such things are not moderate drinkers, and had better beware. A moderate drinker takes a very limited quantity once or at most twice a day, with food, such a quantity as does not make him stupid or even sleepy, such as leaves him cool and unexcited. The moderate drinker takes the lightest forms of alcohol, and takes even these with care. He knows the power of alcohol to produce disease, and is on the look-out for any indication of harm or excess. We do not think it proved that such persons become drunkards. It is terrible, however, to see how soon a drunkard is made by thoughtless drinking, and how complete is his physical destruction often before he, or perhaps she, comes under medical notice. Jaundice, or dropsy, or albuminuria, or delirium tremens, may have been reached before friends, unwilling to admit what they fear, will send for the medical adviser and make a clean breast of it. Alongside all the teetotalism that exists, there is still an appalling amount of tippling which does not distinctly intoxicate, but saturates the principal organs, and destroys them more quickly than an occasional debauch. But, as we have said, this is not moderate drinking—it is mortal drinking.

PLEASANT HOURS WITH A MICROSCOPE.

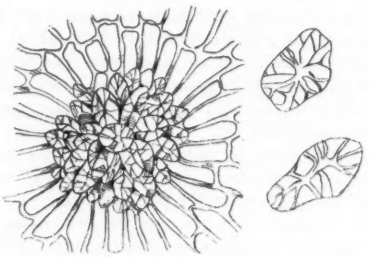
By Henry J. Slack, F.G.S., F.R.M.S.

AT this season of pear-eating every one becomes acquainted with the fact that this delightful fruit contains, besides the luscious, succulent matter, some gritty stuff, especially near the core, but only those who have examined it under a microscope have any idea of its interest and beauty. The bulk of a good pear consists of thin cells filled with the fruity material which is readily digested; the gritty matter called *sclerogen*, or hard tissue, is as indigestible as bits of tough wood, but useful as a mechanical stimulant of the intestine. In the formation of a plant-cell the first process is the deposition of particles to make a thin, delicate tissue. This, when required, is thickened, not by simple additions of layer upon layer, as successive sheets of paper might be stuck together to make a strong body, but by the newly-formed tissue taking in fresh molecules. In many cases all that a plant requires for some of its cells is that they shall be able to hold living soft matter, and carry on processes of endosmose and exosmose—in and out passage of fluid matter—through their delicate walls. Minute differences in the arrangement of the cell molecules, which utterly baffle microscopic investigation, invest cell walls with varying properties, which enables them to give a preference to the entrance or exit of different materials, and to act with different degrees of velocity.

Besides cells containing living and active matter, plants require to be strengthened, so as to give firmness and support; others to unite and construct vessels and pipes of different sorts; some kept open by spiral fibres, like the wire inside flexible gas-pipes; others to be hardened by special deposits.

The growth of these various cells occurs through the activities of matter containing a large proportion of water. Every structure is built up with particles rendered mobile by fluids, and, as many minerals cannot crystallise without taking up a definite quantity of water, called water of crystallisation, so plants in forming organs need what has been called water of organisation, in this respect resembling animals. When a hard tissue is formed, none of the strong matter is deposited without the help or agency of soft matter. The process is not like sticking a layer of wood on to a soft one of cotton, but one in which soft active matter becomes penetrated by the firmer particles. Plant-growth takes place in two or more definite lines of direction, and not in one only. Here we find a process like that of mineral crystallisation, in which molecules are built up in patterns determined by the directions in which the cohesive and repulsive forces operate.

If we cut a little piece out of a pear, near the core, we are sure to find a considerable number of the sclerogen cells, aggregated in little masses, some the size of a small pin's head, others much less. The biggest are formed by the coalescence of a considerable number of the smaller ones, and look much like imperfectly-crystallised milk-sugar. The smallest are composed of a multitude of cells, very hard, transparent, like glass, and exhibiting, when magnified, branching canals. Each hard cell is surrounded by a fringe of thin, delicate cells, seen to be pitted when magnified two or three hundred times. The annexed figures, borrowed from Quekett, show the character of the two kinds, and the observer should compare the sclerogen cells with those of the bone of any mammal, which they somewhat resemble.



A small piece of pear full of these sclerogen cells should be boiled in water for some time. When the pulp is very soft, the sclerogen masses are easily picked out with needles, and should be well-washed to remove the succulent matter. Examined in this state under a power of about fifty linear, they might be taken for aggregations of imperfect crystals. They should then be crushed in a small pestle and mortar if one is at hand; if not, wrapped in paper and pressed hard with a knife-handle. If an attempt is made to crush them with a knife-blade they will start off, as both they and the knife are elastic. The crushing should be done without much grinding, or the specimens will be spoilt. When broken up, the particles should be examined with a hand-magnifier, or a dissecting microscope, and a dozen or so picked out which have been separated from the mass without injury. These can be mounted in Canada balsam, and are well worth preserving. By transparent illumination the fine canals look dark, by dark-ground ditto they come out light and glittering.

The function of the sclerogen masses seems to be that of strengthening the surroundings of these ovaries, and protecting the seeds. A similar growth of sclerogen gives hardness to the shells of stone fruit.

The student should make sections of peach-stones and similar things, and examine those of the ivory-nut; the fruit of *phytelephas macrocarpa*, a pretty palm-like plant, the ivory tree of S. America. The compound teeth of some animals, such as the Cape ant-eater (*Orycteropus capensis*), and of the rays afford instructive comparisons. The ivory tree (*Phytetephus*) is hardened albumen. It is soft when the nut is fresh-gathered. The meat of the cocoa-nut is a similar structure with the hardening not carried beyond the tough state. Thin sections of pear-seeds should be examined. Their albumen is comparatively soft, and its cells very different from those of the sclerogen.

OPTICAL RECREATIONS.

By a Fellow of the Royal Astronomical Society.

COLOUR AND LIGHT.

WE have seen how what we call white light is really composed of a mixture of coloured lights; such colours having their origin in the length of the æthereal waves which produce them; and in Fig. 2 (p. 16) we have represented the chief or most salient colours of the spectrum as consisting of violet, blue, green, yellow, and red. These were long considered as primitive or undecomposable colours. By-and-by, though, we shall see that (to adopt a phrase from arithmetic) we have not even yet reduced

our spectrum to its lowest terms; and that in reality three colours, and three only, in various combinations, go to make up the hundreds of thousands of compound tints and hues which glorify the face of nature. For the present, disregarding any intermediate shades, we will deal, for simplicity's sake, with the spectrum of the five colours which we have specified above; regarding them as pure when produced by the projection by a prism of the image of a narrow sun-lit slit. The effect of the mixture of white light with any of them we shall see immediately. This much premised, we will endeavour to investigate the different ways in which the colours are produced which we see around us. With two of these ways we have already dealt in this series of papers. Interference was treated of on pp. 319 *et seq.* and 540 of Vol. VII. of the weekly issue of KNOWLEDGE; and polarization referred to on p. 307 of Vol. VIII., and again on p. 17 in our November number. It is though scarcely necessary to add that the colours due to polarization are never seen under ordinary circumstances, and require special apparatus to exhibit them. We here propose to treat of reflection and absorption.

Now our first experiment shall be made with a tumbler of clean water and a little milk. In the outset, if we let a beam of light fall upon the surface of the water at any moderate angle, we know that part of the light will be reflected and part will pass through the water; both transmitted and reflected light being alike colourless. Let us now, though, add a little milk to the water and let us look down upon it. The reflected light will no longer be colourless; it will exhibit a decided bluish tint—a fact popularly recorded in the slang appellation of "sky-blue" to the watered milk of the respectable English tradesman. From this it is obvious that the minute globules of milk diffused throughout the water reflect the blue rays out of those composing the white light which falls upon them, and in some way absorb or suppress the rest. But suppose that, instead of looking down on to the surface of our milky water, we look through it—what then? Shall we see the transmitted light of a blue tint? Not at all. It will, on the contrary, appear yellowish. Thus it is evident that under certain circumstances, milk, in a fine state of subdivision, divides white light into yellow and blue light. It is almost needless to add that if we continue to add more and more milk to the water, the blue tinge will give way to a white one; though it may not be quite so familiar a fact, that the light passing through the mixture will, as the milk increases in proportion, become yellow, then orange, and finally red, prior to the opacity of the milk becoming so great as to shut out all light whatever.

Analogous phenomena are exhibited by wood smoke issuing from a cottage chimney, which, as everyone knows, shows as of a pale bluish white as seen against a dark background of trees, but appears brown against the light of the sky. It is, however, the sky itself which exhibits this phenomenon on the grandest scale. Space itself is of inky blackness, and the records of aërial voyages show what an awful dark appearance the celestial vault presents when the aëronaut attains any very considerable height. The fact is, as has been so admirably explained by Tyndall, that our atmosphere is filled with innumerable billions of particles so minute that they never descend to the earth's surface at all; snow, hail, wind, and rain being alike inoperative upon them. Now when the sun lights these particles they behave in a fashion cognate to that of those of milk in our little experiment just described. They reflect blue and white—or white and blue—light, and this, seen on the black background of space, we see as the familiar blue of the sky. The nearer we are to the earth's surface, the more we get of the white element and the paler the sky tint. If, however, the sky is clear, and the sun is at any considerable height, the yellowish tint produced by the transmission of his rays through the particles of our atmosphere is scarcely noticeable save in his immediate neighbourhood. When, though, he approaches the horizon, his light has to pass through a greatly-increased thickness of the atmosphere and its contents, for a reason which a moment's study of Fig. 5 will render apparent. Here E represents the earth, A an observer on its surface, the white ring surrounding the earth indicating the atmosphere. If now the sun, S, is in the zenith of the observer—*i.e.*, right over his head—its light has only the thickness A B to penetrate. When, however, the sun is setting, as at S', its rays have to travel through the whole thickness, A B', of air, with the familiar result that as the Sun descends he first looks yellow, then orange, and ultimately when on the horizon fiery red. The reader who has made the little experiment with milk and water described above will now have no difficulty in accounting for this sequence of phenomena for himself. Moreover, a little consideration will show that in the gorgeous and glorious chromatic effects of sunset, both reflection and transmission play their parts. What artists call the "warm" tints for example, the crimson, orange, and yellow, have their origin in transmitted light. The violet, greyish, and steel-blue of the higher sky depend more or less upon reflection, while many intermediate tints are produced by a combination of both. It is not however only at sunrise and sunset that the effects of our atmosphere in the production of colour are rendered apparent. They become particularly marked in clear weather at any hour of the day when we regard the remote distance. Let us take a range of distant mountains as a familiar example. We know, as a matter of fact, that they may consist of bare reddish feldspar, of almost black trap rock, or may be clothed with a carpet of exquisite verdure; but, owing to the miles of intervening air, teeming with its invisible particles, the proper colours of the remote hills are shrouded and veiled, and we see them as of a deep and almost aërial blue or purple. Light and shade, as such, almost disappear, and the summits, peaks, and ridges stand out as though composed of the crystallised material of a cloud. In the middle distance of the landscape, where, of course, the thickness of the veil of light-scattering particles is notably less, the blue atmospheric tints blend with the proper colours of objects, and tend to reduce their luminosity and impart a greyness to them; while as we approach the immediate foreground the local colour of objects becomes more and more pronounced, until they become, practically, pure immediately under the eye of the observer.

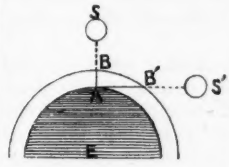


Fig. 5.

The vast importance of a knowledge of these rudimentary facts to all engaged in the art of landscape-painting, whether in water-colours or in oils, as amateurs or professionals, can scarcely be over-estimated. Upon such knowledge depends the power of rendering the varying aspects of any given view with a natural effect. The beginner who neglects to represent the charming influences of the atmospheric transmission and reflection of light, must perforce fail to produce anything approach-

ing to an accurate representation of a landscape. He knows that a field three miles off is green, and he paints it approximately of the green which it appears *when he is in it*. If he would, as Ruskin recommends, cut a hole in a card, through which he could see it, and try to match its tint exactly from his colour-box, he would find, perhaps not a little to his surprise, that it would be in reality rather grey than green at all. We have said this much to show that the question of colour has a practical as well as a merely theoretical or speculative interest. Let us proceed to deal more at length with the production of colour by absorption.

Now it is to absorptive phenomena that practically all our ordinary colours are due. The scarlet of the geranium, the green of the grass and trees, the blue of the artilleryman's coat, the grey of the rocks, the gorgeous hues of the cathedral window, and the range of pigments on the painter's palette,—one and all have this origin. Let us endeavour to gain some idea of absorptive action by the aid of a simple experiment. We must obtain a piece of coloured glass—say blue or red, it matters nothing for our present purpose which. Now let us lay it upon a piece of the dead black paper which we have used in constructing some of our earliest-described pieces of apparatus, and view the reflection either of a candle or of ordinary daylight from its surface. What shall we see? Simply an image of the reflected object in its natural colours, as though, instead of a deeply-tinted reflector, we were employing an ordinary piece of white plate-glass. But if, instead of viewing a reflected image in this way from our piece of, say, red glass, we look through it, we shall see that the source of light, so regarded, will appear red. Now, what has happened? Has the glass actually changed the essential quality of the white light, or what? The arrangement shown in Fig 2, p. 16, will easily enable us to try. As there stated, a beam of pure sunlight, H *b*, dispersed by the prism P, will be spread out on the opposite wall into a superb sheaf of colours, ranging from violet through blue, green, yellow, and orange, to red. While this spectrum is glowing in all its glorious gradations of colour, let us cover the hole in the shutter H with our bit of red glass. What a marvellous transformation we behold! The red, and a good deal of the orange end of the spectrum, is still perceptible, but the more refrangible colours have apparently vanished, and darkness reigns in their stead. Nay, the experiment may be rendered yet more striking if we admit the sunlight through a horizontal slit at H, instead of a round hole, and cover half of this slit with our coloured glass. Then will two spectra be thrown side by side on the screen, and the extent to which the red glass has absorbed the colours above the yellow will be even more strikingly shown. It does not in reality *wholly* absorb even the blue rays, but it needs more refined apparatus than we are employing to show this satisfactorily. Blue glass has the curious property of chiefly cutting out the green, yellow, and orange parts of the spectrum, but of letting through quite a notable quantity of red. The bearing of this upon the ultimate constitution of light will be seen as we go on.

If it be here asked, What becomes of the light which is absorbed by the coloured glass? the answer is very simple. We have seen, over and over again in these papers, that light consists of a series of undulations—in other words, to adopt Tyndall's phraseology, that it is only "a mode of motion"; and what really happens is that these rapid vibrations are converted into slower ones (too slow in fact to affect the eye as light at all), which we recognise as *heat*, and which very slightly raise the temperature of the glass. We are now on the threshold of the explanation of the colours of ordinary natural objects. Take the geranium petal as an example. Looked at in sunlight this is of a vivid scarlet. Why? Simply because, as we have said, the substance of the petal absorbs all the more refrangible part of the spectrum (converting it into heat) and reflects the scarlet light which is left. And here we may revert to our dark-room and prismatic spectrum, Figs. 2 and 3, pp. 16 and 17, for the purpose of performing a most striking and instructive experiment. Let us take our geranium into this room, and passing it slowly up the spectrum, watch the succession of effects. It is needless to say that in the red it glows with an intense red light; but as it travels upwards this disappears until, when we arrive at the green, it is impossible to distinguish the petal from a piece of black velvet. Nor is the reason far to seek. The petal can only reflect red light. There is *no* red light in the green, hence it reflects none at all, and puts on the weird and unnatural black hue of which we have just spoken.

The colours exhibited by dress materials, woollen, silk, &c., have their origin in absorption. White light falls we will say upon a piece of merino. Some of it (not very much) is reflected from the upper surface as from a mirror in the form of white light, but the rest penetrates the fibres of the cloth and is partly returned to the surface coloured from the under part of the topmost bundle, so to speak, of fibres, and partly penetrates deeper into the material, only ultimately to emerge more highly coloured still. It is the combination of these different shades of colour reflected from different depths in one piece of merino, diluted by the white light directly sent back by its actual surface, which forms what we recognise as the colour of the cloth. Silk being much more reflective than wool, gives back a more intensely coloured, richer, and more lustrous light than does wool; while in velvet, the fibres are seen endways, so as to suppress superficial reflection altogether, and this enables the internal reflected light to reach the eye practically unmixed with white light, giving an effect of richness and depth of colour familiar to everybody. The colours of metallic surfaces are referable in like case to absorption, but in this case the light returned from the subjacent layers is considerably mixed with a flood of white light superficially reflected. The powerfully reflective nature of silver is known to all who will read these lines. Lambert has shown that while white paper only reflects 40 per cent. of the light which falls upon it, silver returns actually 92 per cent. of incident light. Water, albeit limpid and colourless if it is examined when in small quantity, shows a very distinctly blue tinge when regarded in any very large volume. The blue of the Lake of Geneva and the almost black colour of the Atlantic will arise to the minds of many of our readers as illustrations of this.

That absorption actually does take place in these cases is shown by the experiment (originally, we fancy, due to Bunsen) made by Tyndall, in his homeward voyage after the solar eclipse of 1870, and subsequently described by him at the Royal Institution, of sinking a weighted porcelain plate in the Atlantic Ocean, and noticing how it gradually appeared bluer and bluer as its distance from the surface increased. Naturally, when the bed of a shallow sea is sandy—and hence more or less yellow—the superficial water looks green from the combination of its own proper light-blue colour, due to absorption with the

light reflected from the bottom. It must be noted that the suspension of foreign bodies in water materially affects its colour, since certain vegetable matter converts the normal blue into a very greenish blue; and we have ourselves seen water brilliantly green, as in a dyer's vat, from the presence of enormous numbers of the *Euglena viridis*. Decaying organic matter tinges water brown, as may be well seen in some of the torrents in the rivers in North Wales; but these are all departures from what may be called the natural colour exhibited by water in great thickness, the blue of which we have already spoken. The green of green leaves presents some curious chromatic anomalies, inasmuch as, with a large proportion of green and yellow, it also contains a little blue and violet and a good deal of crimson! This has been determined by the aid of that instrument known as the spectroscope, a description of which is promised by the Editor of this journal in a forthcoming series of papers on "Light-sifting." Those especially interested in this branch of the subject, then, must, *pro tempore*, take our word for the results thus obtained until the time arrives for an account of the instrumental means by the aid of which they have been arrived at. We may, however, here once more reiterate in a succinct form what we have been endeavouring to explain in some detail, viz., that the colours of objects in the natural world, as we see them, have their origin in the selective action of those objects on white light, certain constituent vibrations of which are absorbed and converted into heat, while the remaining ones (mingled with more or less pure white light superficially reflected) impress the eye with the colour corresponding with their length.

Thus much for the ordinary production of colour. It remains to say something of its abnormal, unusual, or extraordinary production. Bearing in mind what we have previously said (p. 16) about colour, as such, existing only in the sensorium, it is not difficult to conceive that if we can contrive in any way to cause a similar excitation in that part of the brain concerned in the production of the sensation, we shall experience it, albeit we are in total darkness. Thus Helmholtz tells us that an electrical current passing through the forehead to the hand, causes a seemingly wild rush of colours, although no light whatever may be present. Every one, too, coming suddenly out of sunshine into a dimly-lighted church, and kneeling with his head in his hands, must be familiar with the brilliant spectra that pass before his closed eyes. Of complementary spectra we shall have something to say in a future paper. Even a black spiral on a white disc set in revolution in an apparatus to be hereafter described, will, if rotated at a proper speed, seem greenish, and when turned more quickly, reddish; while santonin, taken internally, causes everything white to appear greenish-yellow.

And this brings us to the very remarkable subject of colour-blindness, or total incapacity for seeing certain colours, with which many people are quite unwittingly afflicted. Dalton, the famous chemist, was thus affected. Red and green were absolutely undistinguishable by him; and as he was the first to give a scientific description of this strange infirmity, it is still commonly called Daltonism. So comparatively common is this particular defect that it has been calculated that between five and six per cent. of people in this country are more or less afflicted with it. We have ourselves known more than one person who could detect no difference whatever in the colour of the berries of a holly branch and its leaves, and only recognised them by their shape. Pole and Mivart, among other eminent men of science, are sufferers from this strange defect. The serious importance of its existence will be recognised when we consider how many thousands of people are daily employed on the railways of the United Kingdom, where the conventional signals indicating caution and danger are green and red respectively, the two very colours which more than a twentieth of the entire population are unable to distinguish one from another. Happily this has attracted serious attention everywhere, and we believe that some kind of colour-test is now applied to all signalmen, guards, engine-drivers, and others, whose failure to discriminate between these two colours may be fraught with the most frightful consequences. In 1876, Professor Holmgren found among 266 employés of the Upsala-Gefle Railway in Sweden that thirteen were colour-blind. The test ordinarily employed consists of a series of skeins of coloured wool, which the person under examination is required to match. Seebeck succeeded in making himself temporarily colour-blind by wearing ruby-red spectacles during the greater part of one day. When they were removed he could only discern two colours. A rarer form of colour-blindness exists in which the sufferer sees only (what he calls) red and blue—including yellow in the former designation. Finally, in some rarer cases still, patients have been found practically destitute of any sense of colour at all; in fact, who saw the whole face of nature in mere light and shade, like a mezzotint engraving, a condition of things which may be imitated by the familiar Christmas experiment of salting a spirit-lamp and using the flame thus charged with sodium vapour as the sole source of illumination of a room. How under such illumination all traces of colour vanish and the spectators' faces assume a cadaverous and ghastly hue, very many of our readers know. Something of the sort is seen with the light of the ordinary "snap-dragon" of this season of the year; though the absence of salt from the burning brandy somewhat mars the effect. The physiological causes of colour-blindness are somewhat obscure. It probably has its origin in some actual defect in those parts of the retina which are particularly set in vibration by the red rays. This, however, is a question which we do not propose to pursue here. It is enough if we have conveyed an intelligible idea of the phenomenon itself.

THE SOCIAL WASPS.

By E. A. Butler.

Of the *Vespidæ*, or social wasps, we have seven British species, including the hornet, which is by far the largest and most easily recognisable. The discrimination of the other species is not by any means an easy matter, and needs a very close attention to minute details. But the hornet is at once distinguished both by its size and colour; its hues are brown and yellow, instead of black and yellow, as is the case with all the other species.

Before, however, we can properly understand the differences of the species, or the reasons for their invasion of our homes and their pilfering of our food, it will be needful to sketch the life-history of a *Vespa*. As the plan is nearly the same in all, we need not at present particularise species, but only premise that we choose a subterranean, as being more common than an arboreal, builder.

We begin with a fine old female, or queen, as she is called, whom the warmth of advancing spring has aroused from her long winter sleep. She is an ancient dame,

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one of the few relics of a past generation. She is, too, a widow, having lost her spouse at the advent of the previous winter, because his constitution, like that of all his compeers, was unable to endure the rigour of the frosty season. His progeny are all posthumous, and even yet his widow is no more than an expectant mother. As she issues from her winter retreat, the responsibilities of life crowd thick upon her; she finds herself without a home, without a helper; and yet in a few short weeks she will be surrounded, in a commodious retreat, with hundreds, if not thousands, of her own species, she herself not only their mother, but also their queen.

She has no thought of returning to the old home which was the scene of her youth; that has long since been dismantled, and what with winter rains, and the invasion of earwigs, woodlice, and other such barbaric hordes, few traces of it now remain. So, like her mother before her, she has to undertake pioneer life, and to make a clearing for her future colony. Fortunate is she if she can find some hole—a deserted mouse-burrow, or other tiny cavern—ready to hand; much labour of excavating will thus be saved, and she may begin at once to form the nest. But should nature not thus favour her, she must herself set to work, and by repeated attacks upon the virgin soil with her powerful jaws, gradually hollow out a cavern to her mind.

She will then repair to some oaken fence, or row of palings, and with those same useful tools that she always carries with her, and that have just done such good service as excavators, she will snip off particles of wood, clinging to the fence all the while, gradually working her way along the paling, and leaving behind her a pale streak where the thin outer layer of weather-stained wood has been removed. With a bundle of woody-fibres thus collected she flies away home, and working them up into a pulp with a secretion from her own mouth, plasters them out into a greyish material that looks something like crumpled tissue-paper. This is first formed into a kind of stalk, attached at one point to the roof of her cavern—for, unlike most builders, she does not lay her foundations below, but builds from above downwards. At the extremity of this pedicel, three shallow, cup-shaped cells are formed of the same material, and placed vertically, and with mouth downwards; then a number of layers of the same papery substance are arranged above the cells, so as to form a dome-shaped roof.

Now there can be a commencement of egg-laying; each cell is furnished with one egg, which is glued to its side. The egg soon hatches, and the footless grub that issues from it is said at first to maintain its position in the inverted cell, and prevent itself from falling out of its bed, by a sticky secretion from its own body. The first batch of eggs produce workers, and it is essential for the queen to get them through their metamorphoses as speedily as possible, that she may have assistants to relieve her of some portion of her multifarious duties, which would soon become too onerous for her.

She has now to collect food for the hungry grubs, which cannot provide for themselves, and are entirely dependent on what she brings them. Sailing forth, she will soon seize a luckless fly or other small insect, whose corpse will be carried home, and doled out to the nestlings as they are able to receive it, their mother having made a previous mastication of the morsels. They open their little jaws, each armed with three teeth, and the mother puts the food into their mouths much as a bird would feed her callow brood. Fed several times a day, and fattening on such food, the ugly grubs increase rapidly in size, while the mother enlarges their cells as necessity requires, making them hexagonal in their upper part, and raising their walls by the addition of layer upon layer of her building material, till the grubs are ready to slip out of their larval skin and enter pupa-hood, when her constructive exertions cease, and the larvæ have now to look after themselves.

Each first spins a convex cap of silk, covering the open end of the cell, and then, in the seclusion of this snug retreat, shielded from the curious gaze of inquisitive neighbours, the incipient wasp is "unclothed" and "clothed upon." Not many days elapse before the final change occurs, and, in something under a month from the laying of the egg, the perfect insect is ready to join its mother in her exertions for the enlargement of the home—or rather to relieve her of them. So batch after batch of workers is produced, and each, as it arrives at maturity, takes its share in the duties of nest-enlargement and feeding the young.

When one tier of cells has reached its appointed limits, another is commenced beneath and parallel to it, and connected with the former by sundry tiny pillars of the same *papier mâché*. We note here, therefore, three differences between a wasp's comb and that of bees, viz.: 1st, the combs are made of paper instead of wax; 2nd, they are placed horizontally instead of vertically; and 3rd, the cells are formed only on one side of the comb (the lower), instead of both. The number of insects produced cannot be accurately estimated from the number of cells, because several inmates often successively occupy each. It is manifest, therefore, that the population of the nest, including insects in all stages, is always in excess of the number of cells.

It is not till quite late in the season that the males and females are produced. They are both larger than the workers, and therefore occupy in their preliminary stages cells of larger dimensions than those mentioned above, and those of the females are placed in a part of the nest more or less separate from the rest. The males, of course, have no stings, since this organ is but a modified ovipositor, but both females and workers are provided with them. The males, therefore, may be handled with impunity, and if only one could readily recognise the sex, there would be no hesitation in handling them. When all three sexes are seen side by side, there is little difficulty in separating the males, as their antennæ are longer than those of either of the others; but as this is a comparative character, it is not so easy of application when only a single sex is seen. To some people, no doubt, a stingless wasp may seem altogether incredible, and, perhaps, contrary to experience; but it must be remembered that the majority of the specimens people in general meet with are workers, which regale themselves on our dainties, not for their own delectation only, but chiefly to minister to the wants of the grubs which are their care. The males live only for a short time at the close of the season, and, as they have not the important foraging duties of the workers to perform, they are not so likely to force themselves on our notice.

Wasps are easily affected by changes of temperature; as with most insects, cold has a benumbing influence on them, and consequently the first frosts of autumn begin to tell upon their numbers, and before long the whole population perishes with the exception of a few of the females, who manage, in the shelter of some retired spot, such as in moss or under bark, to survive the winter, and upon these hibernated specimens depends entirely the perpetuation of the species from season to season. Since, therefore, they are so dependent on climatic conditions,

it is not surprising that their numbers are very different in different seasons; in some years, as was the case in 1878 and 1880, they are so numerous as to be a positive plague, and in others comparatively few are seen.

In country places, wasps' nests are not unfrequently found in thatched roofs or under the eaves of houses, as well as attached to beams in lofts, barns, and out-houses. Even the ground-wasps sometimes select such situations, and the hornet, too, occasionally establishes itself in a loft or barn. Sometimes amongst thatch are found numbers of the rudimentary nests constructed by the queens only, which have never advanced beyond their primitive condition, having been, for some reason or other, abandoned shortly after their construction.

The insects themselves are quite omnivorous in their tastes; one might almost say, "Whatever man can eat, that wasps can eat"; the swarms that, in a hot summer, crowd the windows of country grocers' and bakers' shops are a pretty good proof of this. Sweets of all kinds, including ripe fruits, are very attractive to them; but cakes and bread, or even meat, will also be readily devoured. Living insects, too, they catch in great numbers, especially flies, and it has been well remarked that, while they will at one moment be robbing the butcher by devouring his meat, they will at the next be making valuable restitution by devouring the flies that would lay their eggs upon it; and it is probable that the advantage that accrues to us through their destruction of so many disagreeable insects is more than sufficient to counterbalance any loss we may sustain through their attacks upon our fruit and other stores. In catching their insect prey they are very dexterous. Professor Westwood says, "I have watched the common wasp hovering over and darting hawk-like upon flies upon excrement, careful not to soil its own legs and wings." So, too, they will pick flies off the backs of pigs in their styes. They are clever, too, in chasing and dodging insects to catch them on the wing. When the prey is caught, the wings, head, and legs, being more or less hard and dry morsels, are bitten off, and the rest of the body devoured. Flies, butterflies, and even bees are treated in this way. Unlike the *Odyneri*, they do not use their stings in giving a quietus to their prey; the action of their powerful jaws is quite sufficient, without the aid of the more deadly weapon.

They are most industrious in the obtaining of supplies, and well they may be, considering the number of hungry mouths they have so constantly to fill; greedy grubs, ever on the look-out for something good, demand all the energies of even the large staff of workers that are in continual attendance upon them. Sir John Lubbock records a case of one of his wasps, which paid no less than ninety-four visits to a store of honey in one day. And in the performance of these duties they are not only industrious, but wonderfully persistent, and undaunted by obstacles or dangers. The same diligent observer records several instances in point. One wasp had smeared its wings with the syrup on which it was being fed, and so rendered itself incapable of flight; Sir John, therefore, put it in a bottle of water, and gave it a bath, transferring it then to a dry bottle placed in the sun, as the best means of getting it dry. When quite recovered, it was allowed to go free, and after thirteen minutes it returned to the syrup-saucer that had been the scene of its former disaster, and began to sip the liquid with as much avidity as before, evidently quite undeterred by its sad experience. Another was immersed in water till quite insensible, in other words, virtually drowned; on being taken out, it recovered after a while, and at once set to work again at the business of its life, as though there had been no interruption.

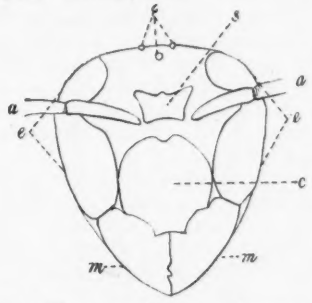


Fig. 1.—Head of Wasp: *a*, antennæ; *c*, clypeus; *e*, compound eyes; *m*, mandibles; *o*, ocelli; *s*, coronet spot.

The head of a wasp (Fig. 1) is a remarkable structure, and well worthy of a close and attentive examination, if only to see what a variety of adornment is lavished on even minute and otherwise obscure parts of the insect, and to marvel at the number of organs that can be collected into so small a space. The entomologist who wishes to distinguish the different species from one another must pay great attention to the minutiæ of this part of the insect, because some of the best distinguishing marks are to be found here. In shape the head is something like a triangular cake with the angles rounded off; it is set on the body vertically, with the base of the triangle placed horizontally, and forming the crown. In front it is slightly convex and behind concave, and it is attached to the thorax only by a small junction in the centre of the hinder surface.

The apex of the inverted triangle is formed by the meeting of the two exceedingly stout and broad jaws, or mandibles, each furnished on its cutting edge with an inner and an outer row of notches or teeth, separated by a groove. They move laterally, and are in most cases attached by a sort of hinge-joint just below the compound eyes. The jaws themselves are yellow, but the teeth black. Occupying the centre of the head, just above the jaws, is an important and conspicuous organ called the clypeus. It is slightly projecting, and is like a broad plate with an outline which is curved above and angular below. This, too, is bright yellow, but it carries certain black marks upon it which vary in the different species, but are in most cases sufficiently constant in the same to be used as diagnostic characters.

Just above the clypeus the two antennæ are inserted, not very far apart from each other, in the centre of the head. Each consists of a long basal joint, the scape, and a stout, many-jointed terminal part, the flagellum. Between the antennæ, and stretching from the base of one to that of the other, is a remarkable, bright yellow spot of most elegant shape. It usually bears some resemblance to a sort of coronet, and situated as it is, just above the equally brilliant yellow clypeus, it suggests, in conjunction with the latter, the idea of a nobleman's coat-of-arms surmounted by his coronet, as though the wasp were carrying the evidence of its rank and identity on its brow; and it is not a little remarkable that in this coat-of-arms, so to speak—viz., the combined clypeus and coronet—we really do find some of the best distinguishing marks of the species.

The sides of the head are occupied by the compound eyes, which, being situated just on the bend, of course command the most extensive horizon possible. They are reniform, or kidney-shaped, there being a deep indenta-

tion in their inner outline at that point which is just behind the antennæ when they are in their most natural position; and it would almost seem as though this limitation to the extent of the visual organs were in some way or other connected with the presence, immediately in front of the spot, of the great black antennal scape, which would certainly render useless for direct vision any eyes situated immediately behind it. Yellow streaks bound more or less of the outline of the eyes, and greatly improve the appearance.

On the top of the head we see three small, polished, glassy-looking knobs, frequently of a ruby or yellow colour, and arranged in triangular form. These are the ocelli, or simple eyes, and their number and arrangement are both very characteristic of the order Hymenoptera; we find the same little organs in bees, appearing like tiny sparkling gems, half hidden by the hairs amongst which they are imbedded. In the Ichneumon Flies, Saw-flies, &c., we find a similar arrangement.

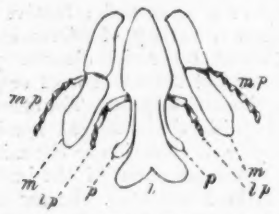


Fig. 2.—Labium and maxillæ of Wasp: *l*, labium; *m*, maxillæ; *lp*, labial palpi; *mp*, maxillary palpi; *p*, paraglossæ.

These are all the parts that are visible from above in the natural position of the organs; to get at the rest of the complex apparatus of the head we must open the jaws, and then underneath we are introduced to a bewildering collection of organs (Fig. 2), as puzzling at first sight as a piece of modern machinery. But a little turning and twisting about, and examination from various points of view, soon enables us to make out the general plan and to see the relation of the parts to one another.

First, and just underneath the position occupied by the mandibles when closed, are two thin, blade-like pieces beset with hairs pointing forwards. These are the terminal portions of the maxillæ, or secondary jaws, which, as well as the mandibles, are capable of lateral movement. Tracing them back to their point of attachment to the head, we find that the basal part is of a somewhat more substantial character than the terminal, and that at the junction of the two parts, on the outer margin, each maxilla carries a slender six-jointed appendage, the maxillary palpus. When the maxillæ are moved aside, a single central organ, previously partly covered by them, comes into view; in its front part it is thin, flat, and band-like, but behind it is much thicker. This is the labium, or so-called tongue. The flat portion is rather deeply bifid in front, and carries two narrow organs, the paraglossæ, attached to its sides, but not quite reaching the tip; thus the free edge of the labium presents four rounded divisions. Further back it carries two jointed appendages, the labial palpi; they are stouter than those of the maxillæ, and are only four-jointed. It is this tongue that the insect uses as a trowel in its plastering operations, when it is manufacturing its nest. When the mandibles are closed, they almost entirely conceal all this mechanism, only the tips of the palpi being visible.

From the above description it will be evident that a wasp's head is not quite so simple an object as it might at first sight appear; nevertheless, there is no great difficulty in making out for oneself all the above points. Only two tools are necessary, a needle to open out the mouth organs, and a hand-lens to examine the different parts. The examination is best conducted on an amputated head. The junction between head and thorax is so slight that there is no difficulty in decapitating a wasp (a dead one, of course!), and if a stout pin or the end of a match cut down to a point be inserted in the small hole that will be found at the spot where decapitation took place, and the head be thus impaled after the fashion in which the authorities in this country once upon a time delighted to treat the heads of political offenders who had suffered death for their indiscretion, the head may be more conveniently handled and placed in any desired position for examination.

We must defer the consideration of the different species of wasps till the next paper.

MOVEMENTS OF THE PLANETS.

By Richard A. Proctor.

THIS month I give the movements of the four inferior planets, Mercury, Venus, the Earth, and Mars, leaving to a later opportunity such explanatory diagrams as may seem required to represent the motions of Mars with regard to the earth. I give also a map (taken from my zodiacal series, showing the path of Mars during the opposition of 1886, or really from November, 1885, to July, 1886). Each diagram explains itself.

The following alterations should be made in the chart of the solar system facing p. 8; (in the second edition of our first monthly part, the chart was I believe corrected):—Change 1889, outside the orbit of Neptune into 1885, and *vice versâ*; 1886 into 1888, and *vice versâ*. In other words, date the five points on the orbit of Neptune from Jan. 1, 1885, to Jan. 1, 1889, the reverse way. Alter Jan. 21 outside the orbit of the earth, to June 21. With black ink hide the vertical straight line caused by a split in the block. Note that the numbers round the orbits indicate thousands of days from the supposed starting-point in longitude 180°.

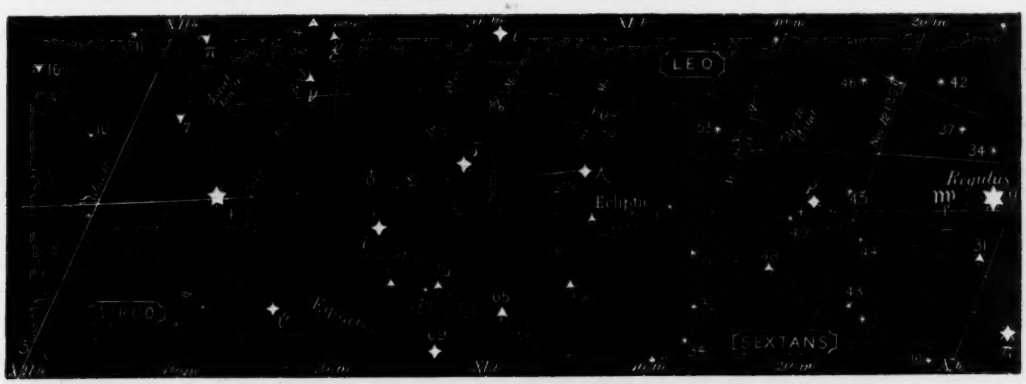
MUSIC.

By Baroness Von Gottrau.

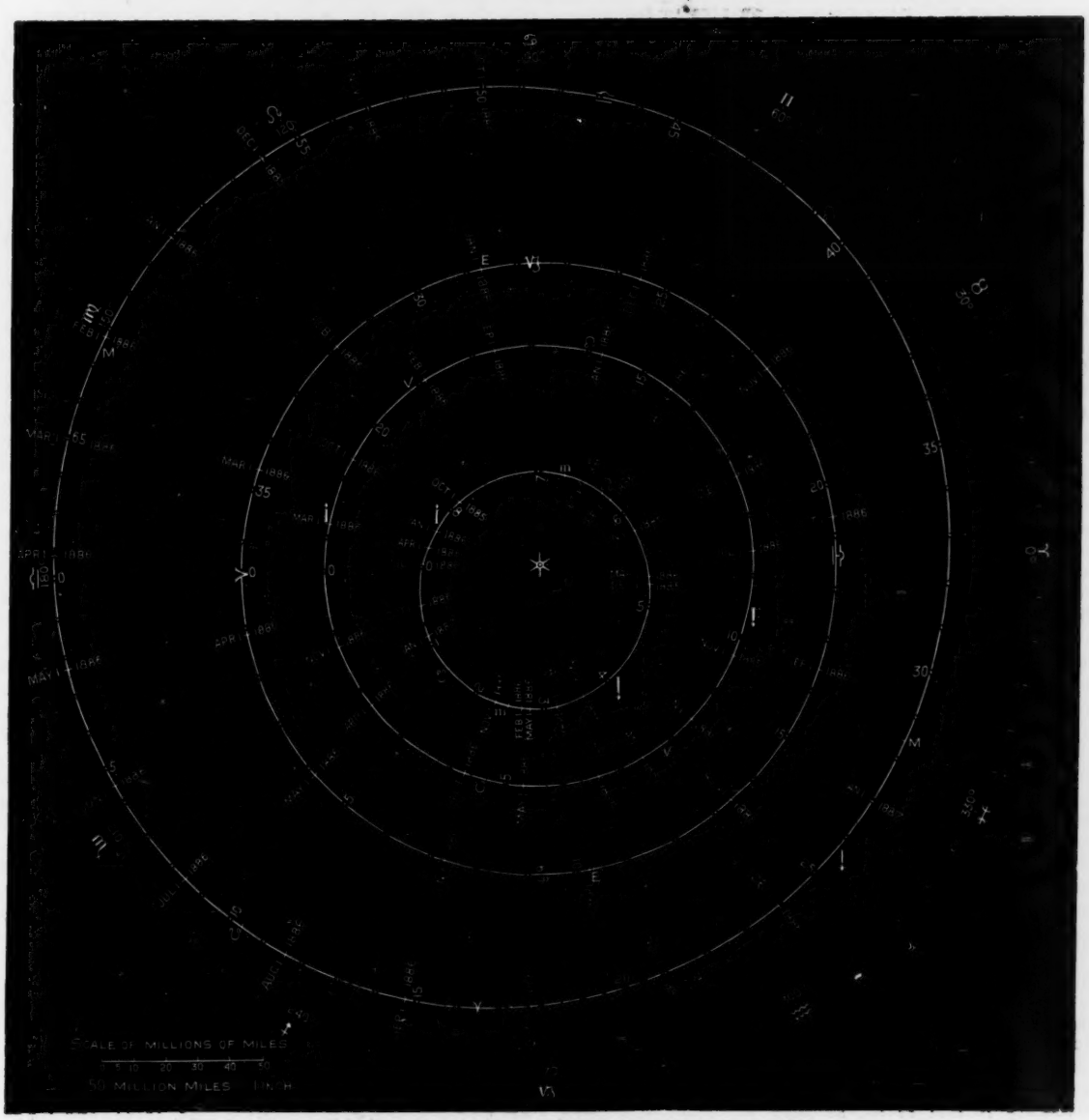
Introduction.

IT is not, I believe, the object of this magazine to publish the history of any particular subject, therefore it is not my intention to give in these articles a record of dates of when certain composers lived, what they composed, when certain musical instruments were invented, &c. But I would like to write about the old musicians and composers, also the composers and musicians of our time, and, in fact, about the study of music in general.

I have met persons who thought of music *only* as a combination of different tones or sounds, and would be pleased to listen to a certain piece of music, because at the moment those particular tones seemed to suit their disposition; but they would give not a thought to the meaning of the music, for to them it was simply a combination of sounds — meaning nothing in particular. But what is Music? It is indeed



Path of Mars during the Opposition of 1886.



Movements of the Terrestrial Planets from Oct. 1, 1885, to Jan. 1, 1887.

XUM

the art of combining and arranging tones; and in and through those tones we have the expressions of all ideas and feelings of love, joy, sorrow, beauty, grandeur, nobleness, holiness, respect, and delicacy. The old Greeks classed,—under the head of music the poetry, philosophy, astronomy, and all arts over which the Muses presided; and as far back almost as we have any evidence at all of men, have they given expression to their feelings by different tones of the voice, feelings of gladness and wonder naturally being expressed in higher tones, and depression or sorrow in lower tones. In song, then, was the beginning of the art of tones; and as men have always given expression to their feelings and ideas in this way, have we not then to a great extent in music the history of peoples? In books, of course, we find the minute history of nations, and we learn from them about dates, facts, and character; in a picture the artist can actually put before our eyes only one certain moment of an act, or one degree of an idea or feeling—though certainly they may *suggest* much more to us; and in architecture we can see the progress of man both practically and artistically. But in music we are made to feel with the people at every moment and in every degree; for the composer plants the seed, as it were, and then, through the wonderful harmony and still more wonderful modulation of the tones of expression, we are carried along with him in the progress and growth of this seed, until at last the whole opens ripe and full to us.

But, of course, not every one can at once understand and appreciate a master-composition, no more than every one can at once understand and appreciate a master-picture. All art, to be properly appreciated, must be studied; thought must be given to it. If a person who had never seen many good pictures, nor given much thought to the art of drawing and painting, should suddenly be placed before a master-picture, he could not at once see and appreciate the fine points of the picture, though the whole would seem pleasing, and probably very interesting to him; but a student in this art would at once notice every detail—every feature of the face, every branch of the tree, every light and shade, and if all be properly executed. In this same way do some persons hear a musical composition; it sounds pleasant to them, but to a student every degree of modulation, every chord, and, in fact, each tone, contains some particular meaning and expression.

For example, a lady, a friend of mine, who has talent for interpreting some music very nicely indeed, after playing one of Beethoven's piano compositions for her father, asked him how he liked it. "Oh," replied he, "that is tolerably nice." But after his daughter had explained the meaning of those tones, how the soft, sweet, melodious murmur in the beginning was a declaration of tender love, then as answers of rejection came the lover became agitated, and after awhile, as his disappointment became great, the sounds modulated into deep despair, until at last he grew so hopeless that the music sounds as though he would run away from himself,—then the old gentleman would ask, "Please play for me that love-story; it is beautiful and interesting."

But if that piece were played by some one who could not properly understand and feel it, and in the beginning those soft, sweet, smooth, and passionate tones were played coldly and abruptly, and those agitated chords interpreted more as vexation, and the end played like some one doing a hop, skip, and a jump, for fun—how different would the music sound! In the same manner as this love-story is told to us, so have we religion, science, heroism, and every refinement of feeling. In the music of different countries we have told us the character of the different people. The Italian, German, French, Hungarian, Norwegian—in fact the music of every separate nation, even down to the peculiar sway of the songs of the negroes of the United States—how perfectly distinct is each music, and how, in hearing the melodies and harmonies of each people, we seem at the moment to be placed amidst them and to enter their life and feel with them.

What a grand and wonderful art is Music! How beautiful and interesting the relation of tone to tone, and how grand can the modulation from one key into another be made!

We live in a wonderfully musical age, if we think of the time when it was not known that the sounds of the different intervals could be put together and make harmony; or that by lowering one half-tone the third interval of any common chord we could change the expression from playfulness or gladness to weirdness or solemnity. How wonderful the change from that time to a time which has given us the compositions of the great Richard Wagner, where every degree of sentiment and feeling have been so truly represented, and the whole brought to such a magnificently perfect *ensemble!* But it is not time yet to talk of Wagner, of whom there is so much to be said that we shall have to devote to him at least the whole of one article.

As we are to talk about music in general, it will be well in this, the first article, to give a few hints in regard to the teaching of children. Mr. Ruskin says that every one can learn to draw, although not every one can become an artist in painting or drawing; and so I think every one can learn music—at least, learn to sing or play some musical instrument,—though every one cannot become an artist in music. And as Mr. Ruskin says about drawing, so in music has there been a great deal of bad teaching. Nearly all parents wish their children to learn music, as it is a popular accomplishment for every one to possess; but if the teaching of children would always be begun in the proper manner, we would hear a great deal more good music every day than we do.

In the first place the child should be taught to have the correct position of hands and wrists, for if one begins to play with the fingers flat on the keys, is it not a matter of course when they come to play more difficult and rapid passages the fingers cannot possibly pass over the keys or strings either so smoothly or rapidly as is often required? and is it not plain that one cannot play as lightly and delicately with the flat of the fingers as with the tips?

Then very often beginners are inclined to stiffen the muscles of the wrist in trying to make the tones stronger, but this only makes the music sound as stiff as the wrists are held; for it is impossible to make full, round, and flowing tones with a stiffened wrist. It is just as easy to keep the wrist loose and comfortable, and put the strength down in the ends of the fingers. Anything that is stiff cannot be flowing; and one of the great beauties and charms of music is in that flow, or, as it were, the loving attachment of one tone to another. These two faults in players are very easily corrected and explained, and if every one would be carefully taught this correct and easy position of hands and wrists, they would make much quicker progress, and would give more pleasure with their music both to themselves and to others. To most children it seems a tedious task to play *c*, *d*, *e*, *f*, *g* with the five fingers over and over, or *f* sharp, *a*, and *b* with first, third, and fourth fingers repeatedly; but if it be properly explained why

these exercises should be made, it would be easier and pleasanter for them. Every one with any delicacy of feeling likes to hear sweet sounds; then explain to each child how sweetly and still decidedly each tone should be touched, and how smoothly and lovingly they should be connected, instead of jerking the finger off each key or string as if it were glad to have finished with that note.

It is necessary for every one to practise some finger exercises in order to make the fingers more flexible, and if they are explained in this manner the child will love to try to make sweet, smooth tones, and make them embrace each other as if they loved each other, for certainly it is the proper way.

But children should not be kept too long upon finger exercises, for then, of course, it would become monotonous to them. I believe there is no one that would like to listen even to a pretty melody over and over again, day after day.

There is a law of repetition in music as in drawing and painting, and to a student of art there is something solemn in repetition; but we will talk of that later, for the repetition of musical exercises is indeed not an example of that interesting and artistic repetition.

Very much of any one thing is not good for a child, as it would become monotonous, no matter what it might be; so their exercises, after being explained in the proper manner, should often be relieved by little melodies, and these, of course, should be very minutely explained, and taught, above all else, to be played with a loving touch. And then, as the child progresses, the beauties of harmony, the artistic modulations, and the correct *ensemble* of every piece should be pointed out to it, so that after awhile, when it comes to study and hear more complicated compositions, it will more easily understand and appreciate them.

Children wonder why they should be troubled with having to put certain fingers here and there; then carefully explain to them why it is necessary to do so, in order to give smoothness and rhythm to the tones, and try to have them feel how beautiful it is to have one round, full tone glide lovingly on to another of like beauty.

Exactly the same rules may be applied to singing, only then the stiffness and jerkiness will be found in the throat.

And now, as we have the child started out with the right foundation, we will in time see how interesting the study becomes as it goes on from finger exercises and simple melodies up to the wonderful fugues of Bach, symphonies of Beethoven, and operas of Wagner.

A series of articles on drawing and painting will be carried on alternately with these on music, and the relation and similarity of these two arts will be interestingly apparent.

München, Nov. 18.

Mr. William A. Eddy, of the American Signal Service Bureau, calls attention to the fact that the study of the phenomena of tornadoes has advanced so far that predictions of the appearance of these terrible, destructive agencies can be made with a considerable degree of accuracy. Of thirty-eight predictions that tornadoes would occur in April and June of last year, eighteen were verified; of nineteen predictions in June and July of this year, fifteen were generally verified; and where regular tornadoes failed to arrive, violent wind and hail storms partially fulfilled the prophecy. Mr. Eddy thinks that a system of tornado signals should be established at every telegraph station in the tornado States. If the Government will do this much, at least some of the terrible loss of life and property due to tornadoes can be averted. The facts presented by Mr. Eddy fully warrant the small appropriation by Congress which will be necessary to establish such a system of signals.

INDIAN MYTHS.

By Stella Occidens.

N Ottawa myth gives an amusing account of Onaiazo, the Sky-walker. It tells us that many years ago there dwelt an old Ojibwa and his wife on the shores of Lake Huron. They belonged to the beaver family, and they had an only son called O-no-wut-a-qut-o, or he that catches the clouds. They hoped to make a great man of him, and when he was old enough they gave him charcoal with which to blacken his face, instead of letting him eat any breakfast. This is the way he should have observed the We-koon-de-win, or fast, but he did not seem to like the idea. When his mother would not give him anything to eat, he stole birds' eggs, and ate anything he could find. One day his mother found him eating the heads of some fish which had been thrown away, whereat she was very angry, and took the food from him. In its place she gave him coals, and he was so indignant that he would not longer stay at home.

During the night O-no-wut-a-qut-o had a wonderful dream. A beautiful woman came down to him from the clouds. She told him that she had come for him, and that he must follow her. He did so, and soon he found himself floating in the air, higher and higher, till at last he reached the cloud regions. There he found himself in a beautiful garden, and near at hand a splendid mansion. When he entered, he saw spears, clubs, arrows, and other warlike instruments, tipped with silver, on one side of the hall; and on the other side there were things belonging to his fair guide, among them a frame on which she had been weaving a broad, rich belt of various colours (this is, no doubt, intended to represent the rainbow).

Presently she heard her brother coming, and she hid the stranger away. The brother came in. He was richly dressed, with silver all over him, which glistened brightly. After he had had a quiet smoke, he rebuked his sister, saying, "Nemissa, when will you quit these practices? Do you forget that the greatest of Spirits has commanded that you should not take the child away from below? Perhaps you suppose that you have concealed O-no-wut-a-qut-o, but do I not know of his coming? If you would not offend me, send him back immediately." His words were of no avail, so he called the lad, and said to him, "Walk about and amuse yourself. You will grow hungry if you remain there." He then gave him a bow and arrows and a pipe of red stone, as a token of consent to his marriage with his sister.

O-no-wut-a-qut-o enjoyed his new life exceedingly, and wandered all day long through the flowery plains and green valleys, watching the birds with their gay plumage. These were more beautiful than the birds he had seen on earth. One thing he thought very strange. He noticed that every morning the brother (the Sun) disappeared, and did not return till the evening, and during part of the night the sister (the Moon) was absent. One day he went with the brother on one of his daily trips. He had some strange experiences. About midday he became very hungry, and he asked his guide if he could not have something to eat. "Patience, brother," we shall soon reach the spot where I eat my dinner, and you will then see how I am provided." After a while they reached the place, and here O-no-wut-a-qut-o seeing a hole in the sky, peeped through. He saw villages, lakes, fighting, feasting, and dancing, and some young men, on a green plain, playing a game at ball.

"Do you see," said the brother, "that group of children

playing beside a lodge? Observe that beautiful and active boy," said he, at the same time darting something at him from his hand. Immediately the child fell, and was carried to the lodge amid wailing and lamentation. The she-she-gwun of the meeta sang a song in behalf of the child, asking that its life might be spared. "Send me up a white dog," answered the companion of O-no-wut-a-qut-o, and a white dog was killed and roasted. Part of it was divided among the people, and part of the roasted animal was sent up to the sky by the master of the feast, who said, "We send this to thee, great Manito." After the two wanderers had eaten their dinner, they returned to the lodge by another path.

Soon, O-no-wut-a-qut-o became tired of this easy life, and longed to return to the friends he had left behind. With much reluctance his wife allowed him to return, saying, "Since you are better pleased with the cares and the ills and the poverty of the world, than with the peaceful delights of the sky, and its boundless prairies, go! I give you permission, and since I have brought you hither, I will conduct you back; but, remember, you are still my husband. I hold a chain in my hand, by which I can draw you back whenever I will. My power over you is not in any way diminished. Beware, therefore, how you venture to take a wife among the people below. Should you ever do so, you shall feel the force of my displeasure."

As she said this, her eyes sparkled, she raised herself on her toes, and stretched herself up with a majestic air; and at this moment, O-no-wut-a-qut-o awoke from his dream. He did not heed the words of his spouse, and married a beautiful young woman, who died four days after. He married again, but this time he disappeared, and it is supposed that his sun-wife had called him back to her home in the clouds.*

There are many quaint Indian stories about the moon, who was supposed to be the Goddess of Night, Water, Darkness, Rest, Death, and sometimes of Sleep. Among the Hurons the word for the moon is derived from the word for water, and in Aztec theology the words for moon and water are often confused. In the same way the words for sun and fire are alike in some of the American languages. In Peru the festival of the God of Water was held at full moon, and in Mexico the crops were regulated by its different phases.

The Brazilian mother carefully guards her child from the moonlight, believing that the rays of the moon will produce sickness.† The moon is supposed to produce dampness, which causes so much sickness and death; it throws parts of the earth into deep shadow, wherein may lurk a hidden foe; and the cold light of the moon is regarded as in opposition to the warming rays of the sun, which bring brightness and comfort to all on earth. We can understand, then, that to the wild Indian the moon should be as an evil spirit, all its effects being regarded as harmful. She is supposed to send dreams both good and bad, and can please or torment at pleasure. Of this the story of O-no-wut-a-qut-o is an instance, the moon herself taking part in the dream.

The Algonquins believe that the moon is a female spirit, wife of the great Manito, whose heart is the sun; whilst the Ojibwas believe that she is the sister of the sun. The Algonquins believe that the moon brought death and disease on earth, and she is supposed to kill men, making them die a wretched death.‡

* Schoolcraft. "Hiawatha Legends," p. 228.
† Brinton's "Myths of the New World," p. 140.
‡ In Egypt it was supposed that Isis, the goddess of moisture (Isis being also the name of the moon), caused all sickness, and sacrifices were offered to her in propitiation.

The Aztecs believe that when the sun first disappeared in the west, and the whole earth was left in darkness, a victim had to be offered up for his return. A leper was chosen, named Nanahuatl, and he was burnt on the funeral pyre. Metzli followed his example, and as she disappeared in the flames the sun rose in the east. Metzli is, no doubt, the aurora or morning light, in whose glory, as it gilds the east, the moon wanes.

It was supposed that dogs were in some way related to the moon, because they were observed to bay at her. The practice has cost them some pains and penalties.* It is the custom among many races, such as the Peruvians, Tupis, Creeks, Iroquois, Algonquins, and the Eskimos, to beat dogs during an eclipse.† These races imagine that the eclipse is caused by a great sun-swallowing dog, and they imagine that he will stop on hearing the howls and cries of the dogs on earth. This sun-swallowing dog is the Goddess of Night, who tries to darken the world during the day. "The ancient Romans sacrificed dogs to Hecate and Diana; in Egypt they were sacred to Isis. Thus as traditionally connected with night and its terrors, the Prince of Darkness, in the superstition of the Middle Ages, preferably appeared under the form of a cur, as that famous dog which accompanied Cornelius Agrippa, or that which grew to such enormous size behind the stove of Dr. Faustus."

The dog is supposed by the Shoshones to be their ancestor, and the Nahuas hold the animal in such high honour that it has a temple of its own, a congregation of priests devoted to its service, statues carved in stone, and an elaborate tomb at death. The dog is said to be represented by the god Chantico, whose audacity caused the destruction of the world. In fact, we see that the dog holds a very important position in the legendary lore and superstitions of the Indians.

It is natural that eclipses should cause much wonder and surmise among the savages of America. Even in European countries the custom still exists of making a great noise and beating kettles and drums during an eclipse. The idea is, as among the Hurons, that the moon is sick, and that the noise will help her to recover.

As the North Americans imagine that the eclipsed sun is swallowed by a great dog, so the Chiquitos of South America believe that the eclipsed moon has been hunted by wild dogs, "who have caught and torn her till her light is reddened and dimmed by the blood flowing from her wounds. So they raise frightful howls and lamentations, shoot arrows into the sky, and seek in every way to drive the monsters off." ‡

The Caribs imagine that the sun and moon are being devoured by Maboya, the hater of light, whilst in the Tupi language a solar eclipse is described by the words, "Jaguar has eaten sun," and the tribes send burning arrows to drive the beast away from his prey.

It is strange that so little reference is made in Indian folk-lore to the comet, which is of all heavenly bodies the most awe-inspiring. Longfellow refers to Ishkoodah, the comet, in "Hiawatha," two or three times, but merely says:—

> Many things Nokomis taught him
> Of the stars that shine in heaven;
> Showed him Ishkoodah, the comet,
> Ishkoodah, with fiery tresses.

And again he says:—

> He, the Master of Life, descending,
> . . . . . .
> Gleamed like Ishkoodah, the comet.

* Brinton's "Myths of the New World," p. 143.
† "American Antiquities," p. 333 (Bradford's).
‡ Tylor's "Primitive Culture," Vol. I., p. 329.

There is, among the Algonquin myths, a story resembling in places the tale of Cinderella:—

There once dwelt in a lodge in an Indian village a beautiful being who was always invisible, and his only companion was his sister. If any girl could see him, it would be her privilege to marry him, and the girls, being aware of this, were very fond of visiting the sister, and walking with her beside the lake in the evening. They would often pretend to see the invisible one, but the sister would ask them questions about him which they were unable to answer correctly. They would then return to the lodge together, and eat supper, and all that could be seen of the brother would be his mocassins as he took them off.

This was aggravating. At last two sisters determined to try their luck. They left their third sister to mind the house, and sought the lodge arrayed in all their finery. Here they were welcomed by the sister, who, however, saw through their designs, and was prepared for them. They took the usual walk by the lake, and when the sister asked them if they could see her brother, they declared that they did. She asked them, "What is his moose-runner's haul?" or, "With what does he draw his sled?" and she knew by their replies that they were not telling the truth. She then said, "Very well; let us return to the wigwam." The sisters, however, did not see her brother, and were very angry.

Now their younger sister wished to try her luck, but her face and hands were badly scarred where her sisters had burnt her with hot coals. However, she made herself look as nice as possible, and although her sisters jeered and laughed at her she went on her way. As soon as the sister saw her, she received her kindly, for she knew that the girl had been ill-treated. Walking by the lake, the despised girl saw the brother, and when the sister asked her, "What is his sled-string?" "It is the Rainbow," she answered. "And what is his bow-string?" "His bow-string is *Ketaksoowowcht*" (the Spirit's Road, the Milky Way).

The sister knew by her replies that she had seen him, and taking her home, bathed and dressed her. Her face became radiant with beauty, her hair, which had been burnt off, fell around her in long tresses, and her eyes shone like stars. When the brother came home, he admired her beauty, and seeing that she was dressed as a bride, he smiled and said, "*Wajoolkoos!*" (So we are found out!) "Alajulaa" (Yes), was the sister's reply; and the girl became his wife.*

MR. HERBERT SPENCER ON PRIESTHOODS.†

By Richard A. Proctor.

IN the last number of Knowledge I gave a brief abstract of Mr. Spencer's discussion, in the book before me, of the relations between Church and State. I propose now to consider more generally his discussion of "Ecclesiastical Institutions."

It is hardly necessary to point out that the great value of this work, as of the whole series of works by the great philosopher of our age, resides in the application of the principles of evolution to the subject of discussion. It would be an injustice to Mr. Spencer to say that in regard to the general doctrine of evolution, he is as Francis Bacon where Darwin is as Newton. For Bacon was in many respects but an inexact student of science, and in regard to Newton's special department not only held, but maintained, altogether erroneous ideas, whereas Spencer in every department of science required for his studies has obtained that true general view which is all that his general survey needed or would permit, while in some, and in particular in Darwin's special department, he has been among the foremost leaders in exact inquiry.* Nine-tenths of the subject-matter which my friend Mr. Clodd proposes for example to deal with, belongs to the domain surveyed by Mr. Spencer, where one-tenth only which belongs to the region surveyed and cleared by Charles Darwin.

In the volume on "Ecclesiastical Institutions," Mr. Spencer has completed the sixth part of the "Principles of Sociology," the parts which remain to be included in the second volume of that great work being those relating to "Professional Institutions" and "Industrial Institutions." We read with much sorrow Mr. Spencer's expression of anxiety lest the completion of these remaining sections should be delayed, or even prevented, by such ill-health as has delayed the appearance of the present volume—which follows the fifth division, on "Political Institutions," after the long interval of three years and a half.

Rightly to understand the evolution of Ecclesiastical Institutions we must recognise the origin and understand the development of the religious idea in man. Is this idea, and especially the thought of deity, innate? This is commonly assumed; but all the evidence is against it. If the deaf and dumb, instructed at mature age, told us that they had always had the idea of a Creator of the world, that of itself would not prove the idea to be innate, because it might well have been derived through inheritance; but as a matter of fact "it has not been found in a single case that an uneducated deaf-mute has had any idea of the existence of a Supreme Being as Creator and Ruler of the universe."† This is manifestly decisive against the theory that the idea is innate.

The lowest savage has no religious conceptions at all. Gradually the rudiments of religion arise as ideas of forces outside himself are suggested in various ways. Mr. Spencer holds by the ghost-theory as explaining this actual beginning of religion; and he seems to be undoubtedly right in regarding it as belonging to the very earliest stages of religious evolution. But I believe there is a yet earlier and more rudimentary form of the religious feeling, excited by the apparent existence of power and volition in objects not really possessing consciousness or even life. We find even the lower animals impressed by a sense of wonder and fear when any inanimate object shows signs of apparent life

* "Algonquin Legends," Leland, p. 303.

† "Ecclesiastical Institutions": being Part VI. of the "Principles of Sociology," by Herbert Spencer. Williams & Norgate, London, 1885.

* In a sense, indeed, it was true of Darwin as Mr. Grant Allen has said, that he took the whole world of science for his special province,—which recalls Bacon's boast. But it was also true, that his mind with all its vastness was not profoundly analytical. The task of working out the psychological and metaphysical aspects of evolution fell rather to the great organising and systematising intellect of Herbert Spencer. So again in dealing with the phenomena of physical and mental heredity Darwin failed where Spencer had achieved a great success. His hypothesis of Pangenesis is "purely materialistic," as Mr. Grant Allen points out, while "Herbert Spencer's is built up by an acute and subtle analytical perception of all the analogous facts in universal nature." The former was "a singular instance of a crude and essentially unphilosophic conception endeavouring to replace a finished and delicate philosophical idea."

† "Church Work among the Deaf and Dumb," Rev. Samuel Smiles, p. 4.

and power; and I take it that among savage races a kindred feeling would long precede the more philosophical stage when the phenomena of sleep and dreams would suggest the idea of the spirit or ghost, leading a separate existence and surviving the death of the body. But undoubtedly so soon as this idea was once formed it would permeate the whole religious system of a community. In the recognition of the "double" would be found the interpretation of the apparent power and volition of objects themselves inanimate. And we can easily understand how in the course of time all plants, all animals, all natural phenomena, rain, wind, snow, cloud, sun, moon, and stars, would be regarded as instinct with life and power derived from the ancestral dead of the community. In this sense and in this way, probably, all forms of nature-worship were originally derived from ancestor-worship. It is more than probable, it may be regarded as absolutely certain, that the belief in One God by whom sun, moon, and stars, earth, air, and sea, were made, who rules all the phenomena of nature by virtue of the powers of these his creatures, was a later development, a purification of the original forms of natural religion. In every case where we can follow the progress of a people's religion to the birth of a belief in one God, we find this belief preceded by belief in many gods, and this belief again preceded by the worship of dead ancestors.

We must look then for the origin of priesthoods to the times when the vaguely-recognised powers of nature were to be influenced or propitiated, and to the later time when the spirits of dead chiefs (and in some cases even of living rulers) had to be approached with due ceremonial observances. The first priests were the medicine-men and weather-doctors, still found among various races, still believed in by the more ignorant even among civilised peoples, as our servants' faith in astrologers and wise women testifies, and as is shown by the publication of such degrading nonsense as Zadkiel's Almanac and the like. The priestly character was more fully developed, when it became part of the duties of the medicine-men to induce the spirits of dead ancestors to yield benefits or cease from inflicting evils,—by bribing them, praising them, deceiving, cajoling, threatening, frightening, or coercing them.

It was natural that in primitive communities, the chief who ruled the people and led them in battle should also be the chief priest; and equally natural that, as each community developed, these duties should be divided. The priestly duty commonly remained in the family of the chief,—being discharged by son, brother, or near relative, in some cases by the king's daughter. But gradually, the priestly race became a sect apart, descended perhaps from the royal family but no longer closely connected with the actual rulers. "Influences of sundry kinds tend everywhere," says Mr. Spencer, "to complicate, in one way or other, the primitive course of development. While we see that worshipping the spirit of the dead chief, at first carried on by his heir, is in the heir's absence deputed to a younger brother—while we see that temporary assumption of the function by a brother or other member of the family tends to become permanent where the business of the chief increases—while we see that migrating parts of a tribe are habitually accompanied by some of the village god's direct or collateral descendants, who carry with them the cult and perform its rites, and that when conquest of adjacent communities leads to an extension of rule, political and ecclesiastical, members of the ruling family become local priests; we find sundry causes at work which render this process irregular. Besides the influence which the chief or his priestly relative is supposed to have with powerful supernatural beings, there is the competing influence ascribed to the sorcerer or rain-maker. Occasionally too the tribe is joined by an immigrant stranger, who, in virtue of superior knowledge or arts, excites awe; and an additional cult may result either from his teachings or his own apotheosis. Moreover a leader of a migrating portion of the tribe, if in some way specially distinguished, is likely at death to become himself the object of a worship competing with the traditional worship, and perhaps initiating another priesthood. Fluctuating conditions are thus apt, even in early stages, to produce various modifications in ecclesiastical organisation."

The development of a monotheistic priesthood out of a priesthood essentially polytheistic, is next considered by Mr. Spencer, in connection with the hypothesis (with which, and with which alone, *all* the facts are congruous) that monotheistic ideas are developed out of polytheistic ideas. We find, for example, in the professedly monotheistic religion of the Hebrews archangels exercising powers in their respective spheres and practically demi-gods. In derived creeds we find clear marks of polytheism. As each Fiji chief has a particular god in whom he puts special trust, so, though the followers of Mahomet shed their blood and the blood of others to establish the worship of one god, the Bedouins make sacrifices at the tombs of their saints, and even the more civilised Mahometans "worship their deceased holy men at shrines erected to them." In the Middle Ages and in Catholic countries polytheistic ideas can, even in our own time, readily be recognised. Even among people claiming to have purified their religion from such imperfections, we find a doctrine at least partially polytheistic as understood by the bulk of the Trinitarian community, — without taking into account belief in Satan, which as recognising an independent supernatural power undoubtedly implies surviving polytheism. Nowhere "except among the more advanced Unitarians, and by those who are called theists, is a *pure* monotheism accepted."

Ecclesiastical hierarchies resemble the political governments with which they are associated. In societies which have developed a highly-coercive secular rule we find always a highly-coercive religious rule; and *vice versâ*. Neither the one rule nor the other can be regarded as cause or effect, but the two are developed from a common root, and for a long time can be distinguished but imperfectly from each other. The common result has a common origin in the moral nature of the people. Extreme submissiveness of nature encourages alike the growth of despotic political and of despotic ecclesiastical control; while the presence of that quality which develops in the advanced race into the sense of the dignity of manhood, resists alike the despotism of living rulers and extreme self-abasement in propitiation of deities.

Furthermore it is to be noted that ecclesiasticism in developing societies conduces to cohesion "not only between the co-existing parts of a nation, but between present and past generations." It helps to maintain those characteristics of the society which constitute its individuality. Nor is this quality of ecclesiasticism without credentials. "The life of society has, up to the time being, been maintained under it; and hence a perennial reason for resistance to deviation. Even irrespective of the relative fitness of the inherited cult to the inherited social circumstances, there is an advantage in, if not indeed a necessity for, acceptance of traditional beliefs and

consequent conformity to the resulting customs and rules. For, before an assembly of men can become organised the men must be held together, and kept ever in presence of the conditions to which they have become adapted; and that they may be thus held the coercive influence of their traditional beliefs must be strong."

Among the original offices of the priestood military functions were conspicuous. Among the ancient Germans "the maintenance of discipline in the field as in the council was left in great measure to the priests." Later the functions discharged in connection with war became more exclusively "of the kind called religious." The Samoan priest prayed for his own people and cursed the enemy. In New Caledonia "the priests go to battle, but sit in the distance, fasting and praying for victory." The priesthood among the Comanches, Schoolcraft tells us, "appear to exercise no influence in their general government, but, on war being declared, they exert their influence with the Deity." As an example of this kind of priestly action in relation to war, may be cited the following prayer directed by the chief priest of the modern English to be used at the commencement of a war in which we attacked an alien race striving to throw off an intolerable tyranny,—"Oh chief God of our people"—I have somehow got the prayer wrong, it begins "O Almighty God, whose power no creature is able to resist, keep we beseech Thee our soldiers and sailors who have now gone forth to war, that they, being crowned with thy defence, may be preserved evermore from all perils, to glorify Thee, who art the only giver of all victory," &c., &c. "The military duties of priests among ourselves have" indeed "dwindled down to the consecration of flags, the utterances by army-chaplains of injunctions of forgiveness to men who are going to execute vengeance, joined with occasional prayers to the God of love to bless aggressions provoked or unprovoked."

It must be conceded however that while pagan priests have superstitiously sought for some sign of divine approval before praying for God to assist the fighting men of his tribe, the Christian priest has with calm superiority taken that approval for granted. There was something especially impressive in this confidence when God was invited to bless our efforts in attacking a people who fought against one of the foulest tyrannies the world has known.

Social development tends to restrict the civil as well as the military functions of a priesthood. In advanced societies we find that so far from taking a leading part in civil affairs, priests are almost excluded from them. In this country for example, many of the functions once exercised by ecclesiastics have now passed from their hands; and there are some who are so intolerant as absolutely to doubt whether even the magistracy should be open to clergymen, and to question the wisdom of some of the decisions by which clerical magistrates have astounded lawyers.

Passing over the special question of Church and State considered in the last number of Knowledge we note that Nonconformity, as representing freedom of thought and including what is specially called Free Thought, is a development only found in advanced societies. "The multiplication of sects," as Spencer well observes, "with which England is reproached by foreign observers, is—philosophically considered—one of her superior traits; for the rise of every sect, implying a reassertion of the right of private judgment, is a collateral result of the nature which makes free institutions possible." "Nonconformity increasing as industrialism has developed, now characterises in the greatest degree those nations which are most characterised by the development of the industrial type—America and England."

The moral influence of priesthoods has in every age been subject to the needs of those rulers or ruling orders of which priests have been either the guides or the servants or both. They have always inculcated obedience to the powers that be, so long as these powers have trusted properly in priestly influences, and have sufficiently supported priestly powers. Moral shortcomings may be forgiven—alike in people and in priests—so long as "subordination is manifested with sufficient emphasis."

Of the future of ecclesiasticism, it is sufficient to remark that, as the idea of propitiation is lost, or as men learn to regard it more clearly as an idea essentially degrading to themselves and insulting towards the unknown Power working in and through all things, all observances implying this savage (or at its best essentially weak) thought will disappear; "yet it does not follow that observances will lapse which tend to keep alive a consciousness of the relation in which we stand to the Unknown Cause, and tending to give expression to the sentiment accompanying that consciousness. There will remain a need for qualifying that too material and prosaic form of life which tends to result from absorption in daily work; and there will ever be a sphere for those who are able to impress their hearers with a due sense of the mystery in which the origin and meaning of the universe are shrouded."

DR. W. B. CARPENTER.

THE sudden death of Dr. W. B. Carpenter, under circumstances of a most painful character, is one of the saddest events science has had to chronicle for many years. Science has also sustained a serious loss. It is true that Dr. Carpenter had accomplished fully the original scientific research which has made his name illustrious. It may even be that advancing years and failing strength might shortly have obliged him to seek rest from the work of scientific teaching—especially by lectures—which to the last he did so well. But it is almost impossible to overestimate the value of such teaching, addressed to the general public, by men such as he—veterans from the campaigns of science, recognised leaders in their own line, and known to be thoroughly competent to estimate the full value of the work being done by those who have more recently entered the field. If Dr. Carpenter did not actually teach the more advanced lessons of later writers, if he did not insist upon results to which these later labours tend, he did not reject either those lessons or their results. He had his reasons, and in our judgment they were sound ones, for caution in the exposition of views which startle and even offend the minds of the unscientific—for whom during his later years he chiefly laboured. As he wrote to the Newcastle Sunday Lecture Society (whose president he was) only harm is likely to be done by dwelling on the changes of opinion which advancing knowledge requires,—the steady teaching of the truths disclosed as scientific inquiry proceeds is all that is really required to cause error to die a natural death. Another thought presented in that letter indicates the tenor of Dr. Carpenter's labours in later life. The lecturer's main object, he said, should be to set his hearers thinking,—

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not to define for them what they should accept and believe.

Of the details of Dr. Carpenter's work we do not profess here to speak. Already a full account has been placed before the public. Our object (in the very limited space which was available in these pages, when the news of his death reached us) is to touch on the general purport of his life-work.

Dr. Carpenter took an important part in the researches by which the doctrine of biological evolution was established. If he maintained to the last that "natural selection leaves untouched the evidence of design in the original scheme of the organised creation," it does not follow that his views were at all out of harmony with those which the most advanced thinker of our age has expressed when he says that our conception of the Ultimate Energy of the Universe, being given through phenomenal manifestations "can in no wise show us what it is."

Dr. Carpenter's treatise on "Comparative and Human Physiology" will remain always on the same level with such works as Herschel's "Outlines of Astronomy" and Sir Chas. Lyell's "Principles of Geology." His "Mental Physiology," apart from its scientific value, is one of the most interesting books in the English language. His labours and inquiries in regard to the deep seas were very fruitful, and although it has always seemed to us that he viewed the mechanism of oceanic circulation from the wrong end (regarding the melting of Arctic ice—an effect—as the prime moving cause), there can be no doubt that he did much to correct long-existent errors in that matter. He honoured many societies by accepting various "distinctions" which they offer to the distinguished, and which the undistinguished anxiously seek. As Registrar of the University of London, he contributed greatly to the value of the University system, and widely extended its influence. Born in 1813, Dr. W. B. Carpenter died on the morning of Tuesday, Nov. 10, 1885, in his seventy-third year. His death was the result of a terrible accident—the only consoling feature being that after the first fearful shock the power of suffering was destroyed, insomuch that he passed the last hours of his life in tranquil sleep.

MR. FREDERIC HARRISON ON THE RELIGION OF HUMANITY.

IT is pleasant after the noise and turmoil of election struggles, after being forced to hear so long the harsh discords of abuse and recrimination, after being reminded yet once more that poor humanity cannot even try to advance its own cause without the way being stopped by squabbling politicians (eagerly proclaiming themselves the only leaders, their rivals impostors and worse), to turn to a quieter atmosphere, and to remember the moral issues really involved in political movements.

In his address on "Politics and a Human Religion" at the beginning of last month, Mr. Frederic Harrison dwelt eloquently and earnestly on the light which political contests throw upon the actual value of the religions, the creeds, the ethical systems which contend for men's allegiance.

"A religion, or a moral system of any kind, ought," he says, "to teach us how to live, how to do our duty in the sphere in which we find ourselves. And few kinds of duty can be more real than to ask what should be the spirit and aim that we should give to the government of our country. 'How to make the best State' was the problem presented to ancient philosophers. Tell us, ye religions, ye gods, ye gospels, ye new philosophies of ethic and of evolution—in what spirit shall we vote—by what signs shall we know the sound policy, the best statesmen?"

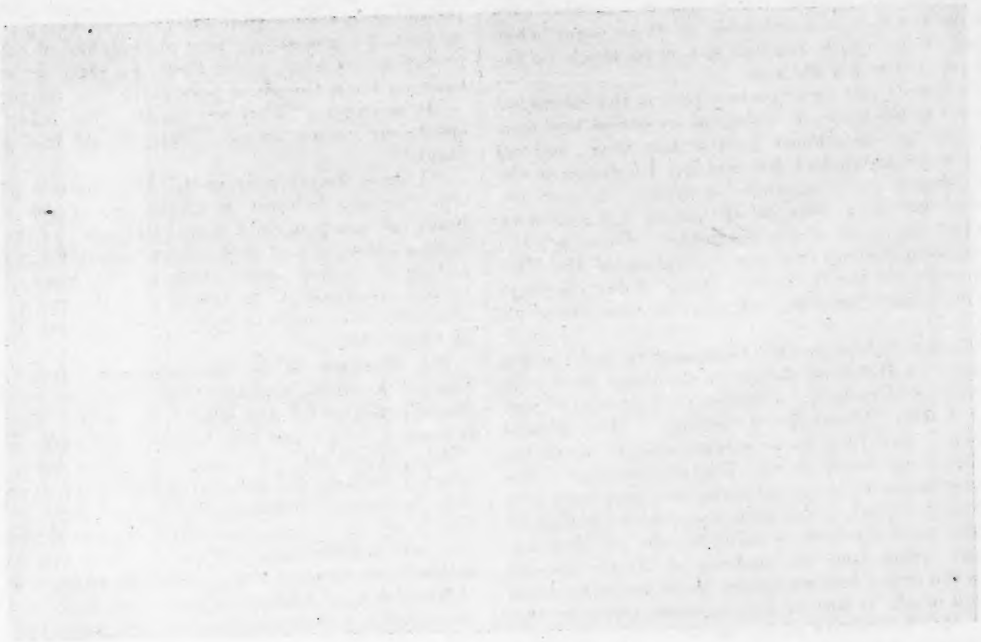
He answers, "They are dumb. Or, when they do speak, our conscience cries out—Would that they *were* dumb!"

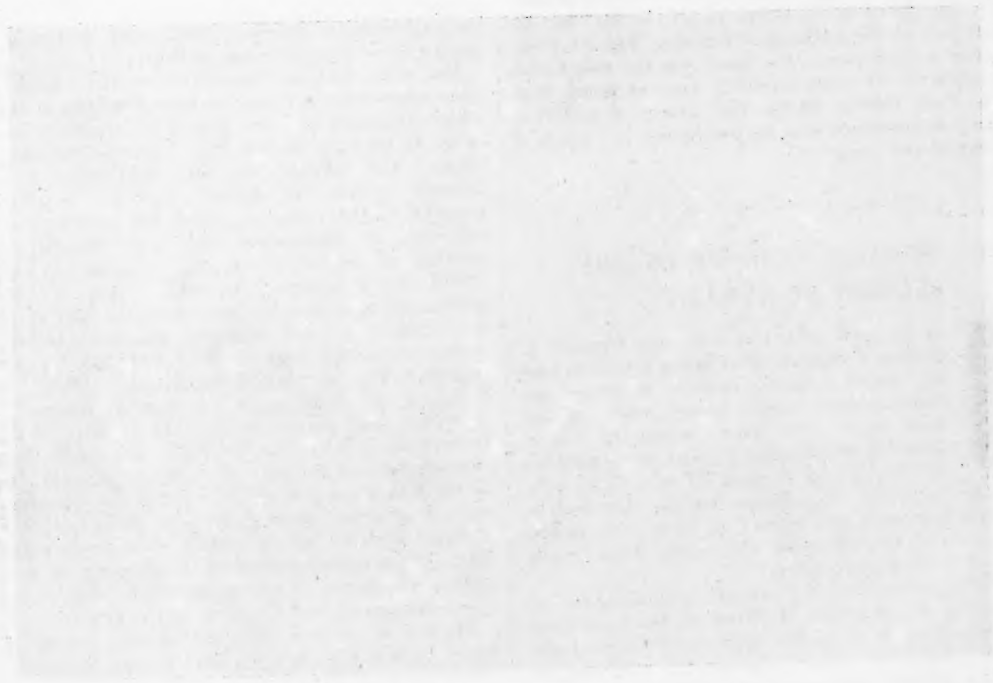
"I am as deeply convinced," Mr. Harrison goes on to say, "as any follower of Christ can be, of the moral beauty of much in the Gospel teachings: of the personal holiness that it can still inspire, especially in the home and in the silent communing of the heart. But the organic weakness of the Gospel is in the world, in public life, in politics, and the higher righteousness of the wise and brave citizen."

Mr. Harrison is no less outspoken against what he terms "the silent, unshaped, but widely prevailing belief that all religion of any kind is *no matter*, that religion has come to an end and has left the earth for ever." "It is impossible," he says, "to argue with those in whom cynicism and self-engrossment have dried up the very fountains of human sympathy and ideal enthusiasm. But to all who retain these sacred springs of moral elevation within their souls, to those who have ever known the hallowed emotions of home, of parent, child, wife, sister; of friendship, of kinship, of patriotism, to those who have ever tried to hold up to their children a standard of right and an object of reverence, to those who in any relation of life have ever known the potency of a high motive and a noble resolve in a social cause:—to all of them we will say 'can you doubt that man's political activity, like his personal and family morality, like his social honour and his good name in his daily work, must be stimulated and guided by a genuine human enthusiasm?'"

He turns next on those who should be his natural allies, those who in trying to learn the laws according to which humanity and the religion of humanity have been evolved, show a thoroughly "genuine human enthusiasm," and indicate the only road along which the advance which he desires can be hopefully attempted. He indicates afresh his seemingly hopeless inability to understand the real bearing of the doctrine of evolution on the religion of humanity. "Will every passion," he asks, "that is known to politics, be exorcised by lectures on the laws of physical development and the analogies which are found in the embryonic morphology? Will ambition be tamed by appeals to the 'survival of the fittest'? Will 'Natural Selection' by itself make a prosperous commonwealth; or will a true patriot be bred by a course of study of Protoplasm? Why, you had far better, for the formation of character and the duty of a citizen, go to the 'Sermon on the Mount' as your guide, with all its extravagance of morbid quietism, than go for your guide to the 'Origin of Species,' with all its wealth of scientific suggestion. Nay, the transcendentalism of 'Cosmogony' is even more alien to the duties of active patriotism, than is the transcendentalism of the 'Kingdom of Heaven.'"

He fails to see that moral enthusiasm, resting on social forces by which, as he truly says, human duty and human character must be trained, is itself a product of evolution. "The battle of justice and injustice, selfishness and self-devotion, folly and wisdom, in the ordering of nations, need the highest controlling powers to which men can appeal. They compel us to resort to human enthusiasm





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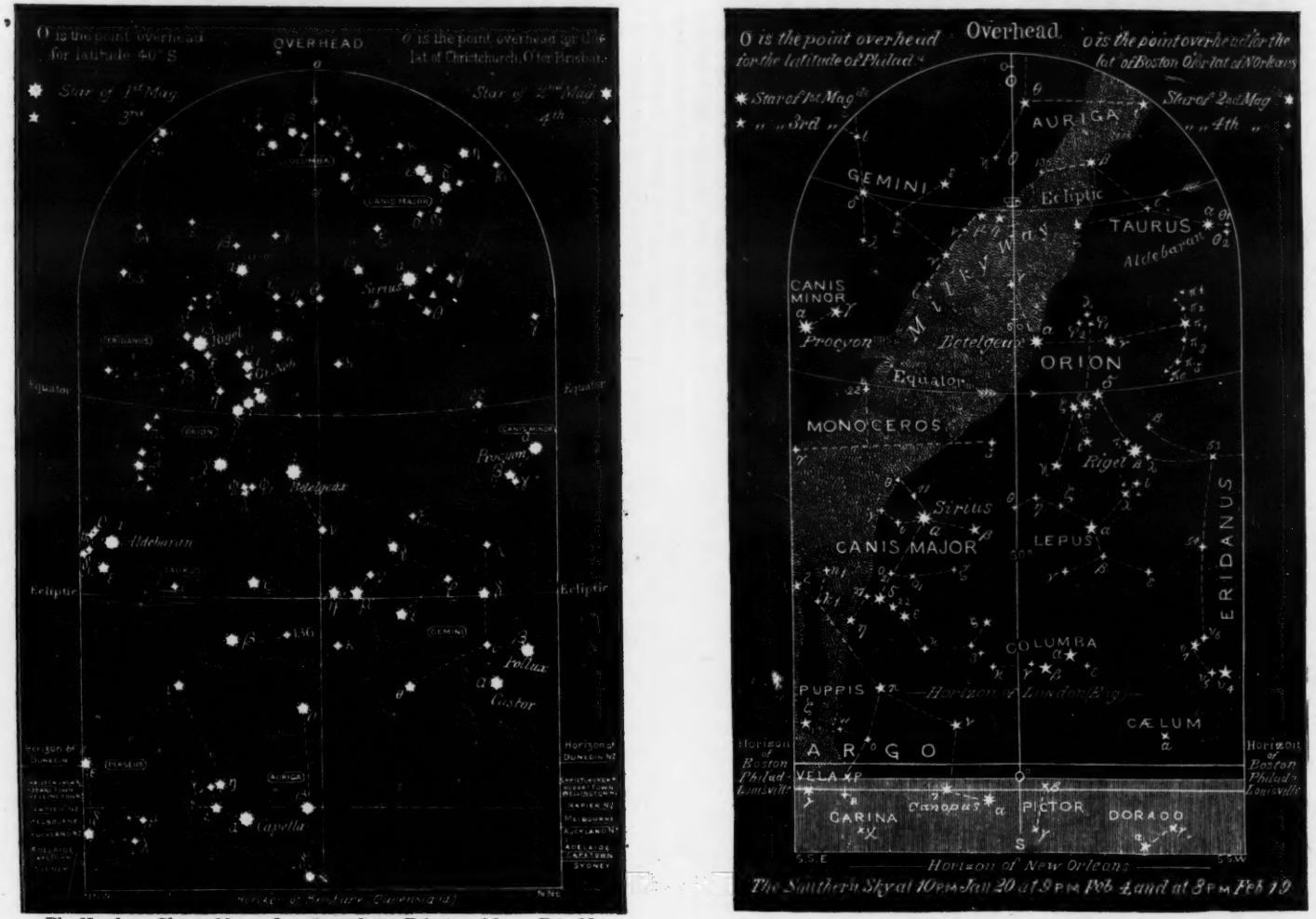

The Northern Sky at 10 P.M. Jan. 20, at 9 P.M. Feb. 4, and 8 P.M. Feb. 19.

The Stars seen towards the north from southern latitudes, and towards the south from northern latitudes, at 10 P.M. January 20, at 9 P.M. February 4, and at 8 P.M. February 19.

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and social devotion—that is to a human religion." He is right in this beyond question. But all the more need is there for the recognition and mastery of the laws according to which human enthusiasm and social devotion have been evolved and will hereafter be developed. It is to the study of evolution, which he so despises, that he must turn even for the evidence on which his own opinion is based.

In fact, while Mr. Harrison is probably the ablest, as certainly he is the most eloquent advocate in England, of what is strangely called the Religion of Humanity, there is no man living who has implicitly expressed more utter hopelessness as to the future destiny of humanity.

Doubtless he feels as he says, "A deep and living trust that the mighty stream of human civilisation is not destined to waste itself like the Rhine in trackless swamps, but will pass on whilst the race continues, in a fuller and stronger tide; a trust that this mighty stream is one which each little drop of our own lives can deepen and swell, whilst it gives to that drop a true course, and a value in the sum of all things." Yet he has rejected and opposed Herbert Spencer's teaching that in all the religious systems the human race has known there is a common element of truth. And how can humanity, with all that its history teaches of the universality of the religious feeling, be presented in a more utterly hopeless case than by the teacher who thus maintains that hitherto the mighty stream of human civilisation *has* wasted itself in trackless swamps?

On the other hand, he who believes that there is a common element of truth in all the religious ideas men have held, who sees that the progress of the human race implies the action of a law of evolution of which the sense of duty, the desire for advance, the enthusiasm for good (even the earnestness of Mr. Frederic Harrison and his zealous fellow-Positivists) are products, may reasonably hope for what Mr. Harrison sees in the future of humanity but should logically reject.

THE SKIES OF THE SOUTHERN HEMISPHERE.

By Richard A. Proctor.

I GIVE another example of the sky seen from our northern hemisphere towards the south, and from the southern hemisphere towards the north, each map being shown on the same plan and scale. Next month I begin the series of twelve maps of the southern skies, on the plan which I have already adopted for the northern skies, only that instead of latitude 51½ degrees south, which would only suit Patagonians, I adopt 38 degrees south, which suits well all the most important centres of population in the southern hemisphere.

The American barque *Crusader*, Captain C. H. Scott, has been lying in the Regent's Canal Dock for inspection. The *Crusader* has just made the first successful transatlantic trip with a cargo of refined petroleum in bulk. This is the initial movement in what promises to revolutionise the present system of ocean transportation of petroleum, turpentine, and other liquids.

In 1874 there were 117 rag-stores in Marseilles, of which forty-six were in one district. In that district the number of dead from small-pox was three times larger than in any other district, while of 157 cases of death sixty-four occurred in rag-pickers' houses or in houses in close proximity to rag-pickers' or rag-stores. In that district M. Gilbert found a cellar, a secret store-room for rags, which infected six persons, of which four died.

CHARLES DARWIN.*

IT is understood that Mr. Francis Darwin is engaged upon a biography of his famous father, and from the ampler materials at his disposal we may expect fuller details concerning Mr. Darwin's inner and domestic life than are given in this luminous and well-proportioned monograph which Mr. Grant Allen, with the concurrence of Mr. Francis Darwin, has prepared. But the more official story can hardly make the man in all his lovable simplicity, modesty, and sweet temper of mind, better known to us, neither supply a clearer summary of his work during the long years when, possessing his soul in patience, he was accumulating the enormous data on which his immortal theory is founded.

Written with that grace of style—happy vehicle of accurate statement—which is the characteristic of Mr. Allen's work, and which enables him to make the rough ways of science easy to travel over; indeed, so easy that one's only fear is lest the cursory reader may think he has the Darwinian theory at his fingers' ends—this is not a book to be borrowed from Mudie's, but to be read, inwardly digested, and then assigned a place on the shelf by the side of Huxley's "Hume."

The volume opens with a prefatory sketch of the state of biological science at the time when Darwin was born, and traces the shadowy, undeveloped shape in which the theory of evolution which he was to convert from a guess into a certainty then existed. In the following chapter, perhaps the most interesting in the book, Mr. Allen consistently applies the theory of descent with modification, the "evolution of the evolutionist," to his subject, tracing the physical and spiritual ancestry, alike rich and varied, from which Darwin derived his wealth of energy and intellect. Limited though his space is, Mr. Allen succeeds in presenting in a few sharp lines the striking personality of the grandfather Erasmus Darwin, between whose rhapsodical rhymes on the "Loves of the Plants" there are scattered sober descriptions indicating partial glimpses of the theory of which the grandson had full vision.

In the generous spirit of Darwin, who was sensitively anxious to acknowledge his debt to the past, Mr. Allen has played the part of Old Mortality in restoring the obscured names of men who had applied the theory of natural selection in detailed instances, yet had failed to grasp it as a universal. Such, among others, were Patrick Matthew, in his book on naval timber; Dr. Wells, in his speculation on the production of varieties in the human race; and, in a limited degree, Sir Charles Lyell. But, as Darwin himself states in a letter to Haeckel, quoted by Mr. Allen, it was to the much-maligned and gentle-souled Malthus that he was most indebted for the idea of *natural selection through the struggle for existence* which is the central idea of the theory called after Darwin's name. "Darwinism," as Mr. Allen remarks, "is Malthusianism on the large scale; it is the application of the calculus of population to the wide facts of universal life."

No heed should be paid to Mr. Allen's suggestion that his analysis of the theory of natural selection be skipped, for even to those who are familiar with Mr. Darwin's numerous works, the synopsis given of the more important among them, notably of the "Origin of Species," is refreshing to the memory. With the monitory illustrations of arrested development which are supplied in the ossified intellectual state of *savants* who have shrunk from accepting conclusions drawn

* "Charles Darwin." By Grant Allen. Longman. 1885.

from data largely gathered by themselves, Mr. Allen only discharges his duty in including man, spiritual as well as physical, as a product of Evolution, and in applying that theory all round, from the embryonic universe to the embryonic soul. One feels in closing this book how happy was Darwin in his circumstances, how happy in his use of them, and in the recognition which he so quickly reaped. For some work the test of time, the perspective of ages, is needed. The fashion of this world passeth away, and we can rarely predict that its changes will not touch many whom their contemporaries most delight to honour. But we have a sure word of prophecy that no change can impair the value or retard the universal application of Darwin's theory, neither blot from human memory the stainless record of his simple, yet momentous life.

THE CHERSONESE WITH THE GILDING OFF.*

TO her very interesting sketch of life in the Malay Peninsula, Mrs. Innes has given the above title in reference to Miss Bird's book, "The Golden Chersonese." As she says, her own account and that of Miss Bird are both essentially true, although very different, owing to the fact that, whereas Miss Bird travelled under favourable circumstances, everything being made as easy for her as possible by officials who were anxious to win her approbation, Mrs. Innes lived for six years in the country, subjected to trials, dangers, and sufferings, and without receiving any assistance from her husband's fellow-officers under Government. Mrs. Innes deals in a masterly way with men and manners, and has managed so to arrange her narrative that there is not a dull page in it from beginning to end. Subjects which in other hands would be uninteresting, she tempers with ever-ready wit, treating what we should call hardships as amusing trifles, but leaving her readers none the less impressed with her fortitude and personal courage. Perhaps this characteristic is most striking in her description of the murder of Captain Lloyd at Pangkor, at a time when she was staying with that gentleman and his wife. Mrs. Lloyd and Mrs. Innes only escaped death by accident, the murderers, a band of Chinese robbers, having left them for dead in their rooms at the Residency, where they were afterwards found by the Malay chief who came to their assistance. Writing from hard experience, Mrs. Innes would dissuade Englishmen from undertaking the position of collectors in Native States under Protection; the hardships of such positions are many, and the expenses so great, that the salaries given are quite insufficient; moreover, the Government so neglects the health and welfare of these officers, that their very existence is rendered difficult.

Hydrogen in Zinc Dust.—It has long been known that shippers are unwilling to carry large quantities of zinc dust in their vessels, owing to the danger of its getting moist and becoming heated to a dangerous extent. Mr. Greville Williams, F.R.S., has recently made some researches which throw light on this matter. He finds that wetted zinc dust, after drying, gives off nearly double the hydrogen that unwetted dust gives. Hydrogen is absorbed from a moist atmosphere at moderate temperature by zinc dust. It has, in fact, the power of occluding hydrogen after the manner of spongy platinum.—*Engineering.*

* "The Chersonese with the Gilding Off." By Emily Innes. (R. Bentley & Son, London. 1885.) 2 vols.

SOMETHING ABOUT MYNAS.

[COMMUNICATED.]

IN my remarks about sparrows I was rather severe upon their character generally, showing that there was nothing lovable about the crew. Far different is it with the dear, gentle, sprightly, and highly-amusing Mynas. Their sub-family, the Sturninæ, are represented at home by the Starling (*Sturnus vulgaris*).

Our Mynas are natty and sprightly, pleasant in plumage and voice, and singularly amenable to domestication.

The common Myna, known all over India, is unhappily characterised by the dreadful name, "*Acridotheres tristis.*" Fortunately it is neither "acrid" nor "tristis," but whether it may turn out "otheres" I don't know.

It is a very social bird, always associates in flocks, which coalesce at night, and separate in the morning with enormous chatteration.

Like the sparrow, this species always affects human society; but, unlike the sparrow, it does not depend on us for food. It is very fond of building its nest in the eaves of our thatched houses, or amongst the beams supporting the thatch; but, unlike the sparrow, it rarely, if ever, nidifies within doors.

I met with an exception at Peshawar, where, in our dining-room, a pilaster ran up one wall about a foot short of the roof, and afforded a platform of about 18 in. by 4 in. The house had been standing empty, and when we took possession we found that this precarious spot had been appropriated by a pair of Mynas, which had originated a perfect mound of rubbish at the base of the pilaster, falling off the top.

They had obtained access through an open ventilator, and, do what we could, we could not keep the birds out, and were oppressed with their rubbish. At last, by hermetically sealing every inlet, we gained the day; but our triumph was saddened by the reproachful taps of the Mynas against the glass panes of the ventilators.

At pairing-time these Mynas are amusingly pugnacious. After much vituperation and hopping at one another, two birds seize one another by their claws, and then, assuming a sitting posture, peck furiously at one another. A crowd of chattering companions surrounds them, and if all is not fair a third will enter the lists, and there will be a triangular, and perhaps quadrangular, duel, the combatants pecking and vociferating furiously, and the onlookers yelling, "Go it this one!" or "Go it that one!"

If you interfere the crowd will adjourn to the nearest tree, and have it out there with large abuse. I once saw a pair of claw-locked Mynas fall from a tree into a canal at Peshawar. They emerged with difficulty, but only to resume the fight in the next tree. These birds have large powers of imitation, are very easily domesticated, and become docile and affectionate pets.

One of my birds caught the cry of my child so perfectly that its grandmother would toddle about the house after the suffering little one. Another coughed to perfection, but became vulgar, by learning to expectorate; and a third sneezed admirably, but became affected by drawling it out as "a whish—shaw," looking at you with one eye and resting on one leg.

The handsome *Entabes intermedia* or Nipal hill Myna, with its glossy black plumage, and orange wattles, beak, and legs, is *facile princeps* among Mynas.

This fine bird is largely domesticated for its handsome

plumage and powers of imitation, and its feats might easily form a lengthy contribution to these pages, but one must suffice, and this occurred to myself. In July, 1874, I bought a pair of fledglings, intending to take them home when we took furlough in December.

Next door there lived an eccentric medical officer, who was an amateur in snakes; until I knew him, I was under the impression that he kept an enormous farm-yard, for turkeys gobbled, geese cackled, ducks quacked, guinea-fowls packecked, cocks crew, and fowls, chased for slaughter, screamed all day long. Calling one day, I casually alluded to his farm-yard; he burst out laughing, and led me to see it. To my amazement, I found it to consist of a single cockatoo, which thus marvellously reproduced a farm-yard. Well, my Mynas hung silent in the verandah until we went home in December, remained so during the voyage, and until we settled at Brighton in the following January. One day I heard the familiar screams of "a sudden death," and, with Indian associations fresh in mind, fancied that the cook was killing a fowl for dinner.

A day or two after our landlord informed me that I was deteriorating his premises by keeping fowls, and that the neighbours would be sure to complain. On my totally denying the accusation, he replied "That he had distinctly heard various fowl-calls." Disbelieving me, I heard afterwards that he threatened the cook for keeping fowls in fashionable lodgings. Her reply was: "Lor' bless your soul, sir, them is no fowls as you hears, but them furrin' birds which master brought from the Hinjees." And so it was; the Mynas were now, in Brighton, uncorking the recollections which they had bottled up in Lucknow six months before, and we had henceforth to labour under the suspicion of harbouring a farm-yard in a fashionable neighbourhood. All that we could do, in self-defence, was to allow the Mynas to perform publicly, in an open window; but then we always had an admiring crowd of gaping cads on the pavement, which was not convenient. R. F. Hutchinson, M.D.

The Sabbatarians of St. Kilda.—The St. Kildians, says the *St. James's Gazette*, have taught a lesson to the kind-hearted persons who set sail the other day with provisions for them. St. Kilda is a dreary island in the far north, subject to periodic attacks of starvation, and a week ago a steamer left Harris laden by Samaritans with the good things of which the St. Kildians were known to be destitute. It is a comparatively easy matter to stock a ship with presents for the St. Kildians, but quite a different matter to land them. The island is guarded from the outer world by a raging sea that whirls round it unceasingly, and the relief party congratulated themselves when they managed to cast anchor close to the shore. Then they got out their glasses and eagerly scanned the island to see the half-starved inhabitants come rushing towards the steamer. To their bewilderment, not a soul was to be seen. It was a deserted island. Then a stream of people issued from the church, and the arrivals remembered that it was the Sabbath-day. Some of them scrambled ashore, and, hurrying to the chief man, asked him for assistance to get the goods landed at once, while wind and sea permitted. The chief man is the minister, and in St. Kilda he holds despotic sway. He answered the inquiry sternly in the negative. The St. Kildians had other things than food to think of on the Sabbath. Then could he guarantee, it was asked, favourable weather in the morning? for if the wind shifted the steamer would have to be off. The minister was unmoved. "He could only promise that the men would be ready to man their boats as soon as the Sabbath was out, not a minute before, and he trusted that the same Providence which had put it into men's hearts to send them corn and potatoes would keep the wind steady in the north-east." At twelve o'clock precisely the work of disembarkation began, but what were the thoughts of the St. Kildians and the relief party while they waited for the passing of the Sabbath is not told.—[The St. Kildians, through intermarriages within their own race, have so deteriorated that besides being—as above shown—semi-idiotic, half the new-born children die of lock-jaw a few days after birth. This throws curious light on the old and absurd belief that different nations descended severally from single pairs.—R. P.]

Gossip.

By Richard A. Proctor.

I have received so many letters urging that as the Replies to Correspondents (which many seem to have enjoyed!) have ceased, Editorial Gossip should at least not be discontinued, and might even be extended, that it would be discourteous on my part not to respond to the request. Therefore, I have penned a few paragraphs about such matters as seemed suitable for this sort of disconnected chit-chat.

* * *

It is doubtful whether we should regard it as a quaint indication of American character, or rather as illustrating human nature, that when Mr. Shaw (Josh Billings) wrote in good English and under his own name, his philosophy fell dead; when he began to publish ill-spelt and ungrammatical philosophy, under an assumed name, he had a large number of readers. I cannot for my own part quite see why interest should be taken in reading the remark, "If yu seek wisdom, my yung friend, studdy men and things; if you desire larning, studdy dikshionarys," while the same remark properly spelt should pass unheeded. If the former version is found to be funny because ill-spelt, there must be a most imperfect idea as to what constitutes fun and humour; but if the wisdom of the saying constitutes its value, one would say that it would be at least as impressive when properly spelt as with "larning" for "learning" and "studdy" for "study." Would the American public, I wonder, rush in their thousands to buy a version of the Proverbs of Solomon in the "phunny phawm" which Artemus Ward, Josh Billings, and Eli Perkins found so attractive? Would it be more profitable to read,—"Go 2 the aunt, thow slugud, konsidr her wais & B Ys," than to read the saying in the usual form? Or again, "The larfter ov phoolz iz lik the kraklin' ov thawns undr a pott,"—would that have more influence on those who find fun in bad spelling than the saying as usually printed in our Bibles?

* * *

Americans find Englishmen very impervious to American fun, even as Englishmen find Scotsmen impervious to English jokes. A good deal may probably be said in each case on both sides; but many of the stories supposed to illustrate dulness of apprehension rather indicate, I think, a more delicate apprehension of what constitutes real wit. A joke that passes as good in one country may be regarded as no joke at all in another; but that may be because it really is a very poor joke indeed. In other cases, a joke may be taken solemnly by way of joke,—by no means from want of wit. Thus Lamb tells us that when Coleridge drew the curtain hiding his pet picture, saying to a Scottish friend, "What do you think of 'my beauty'?" the Scotsman not apprehending the sense in which Coleridge spoke of the painting as "his beauty," answered, "I think highly, Mr. Coleridge, of your abeelity, but I cannot say I think much of your beauty." And this has been quoted as a sample of Scottish obtuseness! Judging from the Scotsmen I have known, with not (I think) one single exception, that Scottish friend of Coleridge's, solemnly though he uttered his remark, made there the only joke that was missed on that occasion.

* * *

So with the Scotsman who when told that the Kilkenny cats had fought till nothing but two tails were

left, replied after a pause of seeming cogitation, "Eh, mon! but there must have been more than twa tails," had not missed the joke (or he was unlike any Scotsman I have ever met)—he was simply showing his appreciation of its point. One might as reasonably regard the solemn face of every really great humorist as proof of dulness of apprehension.

* * *

Mark Twain mistook in the same way (and oddly enough when one considers the quality of his own humour) the tone in which many English reviewers dealt with his "Innocents Abroad." Spluttering laughter is not the best way of welcoming gravely uttered jests; and it is rather pleasing than otherwise to find that Americans recognise very little that can remind them of the crackling of thorns under a pot, in our English way of welcoming their jokes, from the feeble fun of mis-spelt words to the real wit of their best humorists.

* * *

A valued contributor to these columns has expressed a wish to delete commas before "and," where three or more nouns are brought together. I find myself, in this case, a defender of the comma, who some time since fought against it. (What a convenient word the old "erst" was; here it would have done duty for three.) Logically, it seems to me, if we wish to speak of three things *a* and *b* and *c*, we ought to write "*a*, *b*, and *c*," not "*a*, *b* and *c*": for otherwise we have no means of showing, by the punctuation, whether *b* and *c* are different from *a*, or are included in the same class. For instance, if we write "the ancient inhabitants of England, Saxons and Normans," we might mean either "the Britons, Saxons, and Normans," or "the ancient inhabitants of England,—viz., the Saxons and the Normans," and though in the great majority of cases, the context, or knowledge already possessed by the reader, would make the real meaning clear, it is in my opinion always a fault of style if the real meaning of a passage has—unnecessarily—to be inferred from the context or from antecedent information.

* * *

In many cases, the omission of the comma in order to show that the words on either side of "and" are coupled, is absolutely necessary,—and a single case of this kind shows that the unnecessary omission of the comma involves a fault of style. Thus there is a passage in Cooper's "Pilot" (I quote from memory, and long-long-ago memory) in which Captain Barnstable (or lieutenant, which was it? was it not both, by the way, second lieutenant of the frigate and captain of the saucy *Ariel*?) calls to his crew, "Board her Ariels, greybeards and boys, idlers and all!" Clearly if the omission of the comma before "and" were the rule, the reader's first idea of the meaning of the appeal would be that the Ariels, the greybeards, the boys, the idlers, and all the rest, were invited to board the British cutter. The inspiriting effect of the couplings following the general call, would be altogether lost at a first reading. (I am by no means sure that the word used in this particular call was "Ariels," it might have been "you sea-dogs," or the like, but the principle is the same.)

* * *

In reading French books one often finds the omission of the comma confusing, until one has learned to notice that the spirit of the French language does not lend itself to the bold couplings which are often so effective in description.

Our English printers fell about thirty years ago into the French fashion, and I remember well how confusing the omission of the comma was in the earlier editions of Macaulay's "History of England." I collected several pages of examples of distinct double meanings, some of which were really perplexing, even when the context was carefully considered, and where the reader had plenty of previous knowledge for his guidance. Probably some awful examples of that sort led our printers to return to the more logical method of punctuation. I observe, however, that some writers, like our friend above-mentioned, adhere to the incorrect method. I notice it frequently in the writings of the Head Master of Clifton College.

* * *

It may be thought that my defence of the comma in this case is inconsistent with my objection to it before: but in reality it depends on precisely the same principle. I objected to "and, therefore," because I maintained that "and therefore" should be regarded as forming a double conjunction, not two distinct conjunctions, that in fact the "and" ought not to be separated from the "therefore." In the present case, in like manner, I regard the "and" as too closely connected with the word it precedes to sufficiently mark it off from the word it follows: the comma is as much needed as if the "and" were not there. Only when the noun following the "and" is to be associated with the noun preceding it, is the comma to be omitted; and as its omission implies this close association, omitting it between distinct nouns is wrong.

* * *

We nearly always (perhaps always) get a correct rule for using or omitting the comma, by noting whether in reading there is or is not a "commatic" pause. Now as no reader (not being idiotic) would think of reading "and—therefore" (the dash representing the commatic pause), so I take it no sensible reader would say "the Greek—Roman and Englishman—fought for liberty," with no commatic pause after Roman. If he did he would assuredly make nonsense of the sentence. On the contrary, he would read "the Greek—Asiatic and European—fought for liberty." Therefore the writer should put, severally,—

1. The Greek, Roman, and Englishman, fought for liberty,
2. The Greek, Asiatic and European, fought for liberty.

Observe also that whereas in the first sentence no comma *need* follow the third noun, a comma must follow the third noun in the second sentence. I myself prefer to add a comma after the last noun in all such cases, that is wherever there are more than two nouns, because this corresponds with the commatic pause usual in reading, and better represents the sense. For in the sentence "the Greek and Roman fought for liberty" the Greek is related to the verb as closely as is the Roman; but in the sentence "the Greek, Roman, and Englishman fought for liberty," the Greek and the Roman are cut off from the verb severally by a comma, so that the three nouns to which the verb equally relates are not equally connected with it—which cannot be logically sound.

* * *

I may remark that my own views about all points of punctuation depend absolutely and entirely on clearness of meaning. I make no rules. I simply test each sentence by inquiring what meaning will be given to it by the reader, if punctuated in this or that way and read as punctuated. Among other points which I have been

led to notice in following out this plan, has been the necessity, for scientific and philosophical writing if not for narrative, of a point which would serve as (and might be called) a half-comma.

* * *

My attention has been called to a suggested method of measuring the sun's distance, depending on determining the time when the moon is half-full before and after "full." Theoretically this method is excellent—(it is practically the same which was suggested by Aristarchus of Samos, as described in my book on "The Sun"). The arc traversed by the moon from half before "full" to half after "full" is greater by about 18′ than the arc traversed from half after "full" to half before "full"; for the moon's orbit round the earth (not that she really travels round the earth) subtends about 18′ as supposed to be seen from the sun. In reality, the application of the method effectively, requires that the observer should not only detect but measure accurately within at least one 300th part, the interval of time between the moment when the moon is really half full, and the moment when the sun and moon are 90° apart on the celestial sphere, this interval being the time occupied by the moon in traversing 9′ or one 2,400th part of her apparent orbit round the earth. This would be about 18 minutes of time, and certainly no one who has ever studied the half moon with a telescope would hope to tell within 18 minutes the moment when, taking fair account of her inequalities, she might be regarded as half full. But to get the sun's distance out of this method, with accuracy equalling that already obtained by other methods, the observer would have to determine the moment of true half moon within less than four seconds!

* * *

Reading the last paragraph, I feel that an apology is due to those who are enthusiastic about the dignity of science, for my omission of the sweet word "dichotomy" and its cheerful derivatives. I hasten to make them happy by explaining what I really mean—viz., that no reliance can be placed on the method suggested by Aristarchus for determining the mean equatorial horizontal solar parallax by chronometric observation of the lunar dichotomy.

* * *

I am glad to be able to announce that the change from weekly to monthly Knowledge has apparently met with general approval and has at any rate begun most favourably. Many regret the weekly; but their regrets have been expressed in the kindliest way, and always with promise of support to the monthly.

* * *

We propose soon to begin a series of studies of Shakespearean Characters, by a Student of Shakespeare, each character being made the subject of a single article.

New Books to be Read—and Why.

The Dictionary of National Biography. Edited by Leslie Stephen. Vol. IV. Beal-Biber. (London: Smith, Elder, & Co. 1885.)—Because it is the fullest, most accurate, and most complete compendium of British Biography extant; including such diverse lives as those of Edmond Beales, of Hyde Park railways notoriety; Aphra Behn, Cardinal Beaufort, Sir Henry de la Beche Bewick, the wood-engraver; and Bishop Berkeley, amid a whole host of others.

A Short History of the Netherlands. By Alex. Young. (London: T. Fisher Unwin. 1886.)—Because, without going into the detail, or in any legitimate sense attempting to rival Motley's imperishable work, Mr. Young gives a trustworthy and scholarly history of the Netherlands in a compact and readable form.

History of Astronomy During the Nineteenth Century. By Agnes M. Clerke. (Edinburgh: Adam & Charles Black. 1885.)—Because, although guilty of the questionable taste of conspicuously puffing a notorious self-advertising "astronomer," the authoress has, on the whole, given us a fair and pleasantly-written record of the progress of astronomy during the last eighty or ninety years.

Horse and Man. By the Rev. J. G. Wood. (London: Longmans, Green, & Co. 1885.)—Because it contains a mass of information of the highest value to every man who keeps a horse either for pleasure or profit. Owners of carriage horses who use—or whose servants use—the wicked "gag" bearing-rein, should study Mr. Wood's text and its illustrations.

Wanderings of Plants and Animals. By Victor Hehn. Edited by J. S. Stallybrass. (London: Swan Sonnenschein & Co. 1885.)—Because, though diffuse, it contains a great deal of information on the original habitats of animals and vegetables now very widely removed from them.

Farm Live-stock of Great Britain. By Robert Wallace. (Edinburgh: Oliver & Boyd. 1885.)—Because the agriculturist will find much that is of value to him in connection with the management of the solitary element in farming which at present affords the slightest chance of remuneration.

That Very Mab. (London: Longmans, Green, & Co. 1885.)—Because it is a very witty and amusing satire upon contemporary crazes; characterised by much of Swift's trenchant keenness, while wholly devoid of his coarseness.

Hugh's Sacrifice. By Cecil Marryat Norris—*Through a Refiner's Fire.* By Eleanor Holmes—*A Generous Friendship—Girlhood's Days—Master of his Fate.* By A. Blanche—*The Daisy* (London: Griffith, Farran, & Co.)—*When I was a Child.* By Linda Villari (London: T. Fisher Unwin)—*Prudence Winterburn.* By Sarah Doudney (London: Hodder & Stoughton)—Because, if not reaching the highest level of fiction, they are all sound, healthy stories for the young, containing good morals, and are, in more than one case, decidedly interesting.

From the Tanyard to the White House. By Wm. M. Thayer. (London: Hodder & Stoughton.)—Because it contains a biography of General Grant which will interest boys (though we earnestly wish that Mr. Thayer would never try to be funny).

Queer Pets. By Olive Thorne Miller. (London: Griffith, Farran, & Co.)—Because it puts natural history in an attractive and amusing light for children, who are never cruel to their own actual pets.

The Missing Man. By H. Sutherland-Edwards. (Remington & Co. 1885.)—Because it is a novel of much more than ordinary interest. Belonging to the new school of cheap sensation novels inaugurated by Hugh Conway, it is nevertheless a work written with great care, so that the uncomfortable feeling of impro-

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bability which so often tinges books of this class does not here obtrude itself, at any rate to those familiar with the annals of mental pathology. The madness of Lord Pontefract, who, after a severe shock following upon great mental exhaustion, is led to believe that he is a certain John Robson, by whose troubles he has been greatly impressed, is a skilful psychological study, and his sudden recovery of his personality is equally well drawn. Although the general reader will probably hardly appreciate the genuine merit of the book, the interest of the plot is so great that it cannot fail to become very popular.

There also lie before us, each addressing its own public, *Technical Gas Analysis*. By Winkler & Lunge (London: Van Voorst. 1885)—*Scientific Meliorism*. By Jane Hume Clapperton (London: Kegan Paul, Trench, & Co. 1885)—*Jacob Boehme*. By H. L. Martensen (London: Hodder & Stoughton. 1885)—*Euphorion*. By Vernon Lee (London: T. Fisher Unwin. 1885)—*The Imperial Parliament Series* (London: Swan Sonnenschein & Co.), and numerous serials.

A Metropolis of the North.—Newcastle-upon-Tyne is well-known the wide world over as the great emporium of the coal-trade, which has been carried on here since the days of Henry III., and is popularly supposed in the south of England to be a city peopled by coal-miners, and having coal-mines, in full tide of work, plentifully scattered amongst her streets. Yet you will rarely see a pitman there, except on market-days, when they flock in from the country round, easy to recognise by their gait and their peculiar complexion, which is pale, yet robust and healthy-looking; while, as for coal-pits, there is only one within the city bounds, and that only started work about two years ago, after lying idle some quarter of a century. In the neighbouring country side they are plentiful enough; in some directions as you approach or leave the city, you will see their engine-houses, and the tall, skeleton framework of their coal-drawing gear, looming black against the sky on every side. On Newcastle Quay, the headquarters of the Great Northern coal-field, you will scarcely see a single piece of coal, though as for the offices of the coal-fitters—the successors of the ancient hoastmen of the town, who regulated the vend of coal far back in mediæval times—their name is legion. All down the Tyne and in the docks you will see huge spouts projecting over the water at the ends of the long railways or waggon-ways, which run from the collieries, sometimes miles away; and under these spouts you will see vessels lying, taking in the coal for transport to the furthest ends of the earth.—*English Illustrated Magazine.*

Ants.—Sir John Lubbock gave a lecture on ants at the Royal Victoria Hall, Waterloo-road, on the 3rd Nov., Mr. S. Morley being in the chair. After describing how he kept his ants, and stating that he had two queens which he had had since 1874, the lecturer showed on the screen pictures of queens, males, and workers of various ages. Ants of the same nests never quarrel, but those of different nests are always at war. In order to see whether ants of the same nest recognise each other by means of a password, Sir John Lubbock had made a number of ants belonging to two nests helplessly drunk, and laid them near one of the nests. The sober ants carried most of their friends into the nest, but threw all the strangers into the water which surrounded it. After discussing the powers of smell, hearing, and sight in ants (the last apparently not helping them much to find their way), experiments were detailed on their power of communication, the conclusion being that they can tell their friends of treasure and guide them to it, but do not describe the way to it. After remarks on the industry of most ants and the helplessness of certain slaveholding kinds, which cannot even feed themselves without help, living specimens were projected on the screen of the red slaveholders and black slaves, which had been stolen from their homes in the chrysalis state. Also English queens and workers, and the small blind white insects, found only in ants' nests, and supposed to play the part of domestic animals to the ants. The lecturer concluded by expressing an opinion that the mental powers of ants differed from ours rather in degree than in nature. In thanking the lecturer, Mr. Morley spoke of the science classes lately started at the hall, and enlarged on the advantage to working men, even from a money point of view, of such classes. He announced that Mr. W. L. Carpenter would give a lecture on the 10th, entitled "Fire! Fire! or the Electrical Fire-alarm System in America."

Our Chess Column.

By Mephisto.

AN HOUR WITH A CHESS-MASTER.

MY friend having won the great Tournament, I hastened to offer him my congratulations. I assured him that although I often said (in fun, of course) that he would never eclipse Morphy, yet I always considered him a great player. Having offered sufficient homage to the victor, I asked him, for friendship's sake, to show me his best game. "I am afraid," said he, "that there is a difficulty in the matter; you might wish to see a brilliant game. I could show you several good ones, but my best game is a comparatively dull one." "Pray," said I, "explain the contradictory character of your remark." My friend assumed a dogmatic tone in replying as follows:—

"The finest game is one in which the finest and most brilliant combinations and positions occur. The best game, however, is that in which the attack meets with a strong and stubborn defence, and in which a result either way is obtained by sheer hard play and correct judgment. A well-fought game gives me far more satisfaction than a game in which the opponent's weak play induces brilliant combinations."

"Well," I said, "I do not wish to dispute the point with you, but pray show me a real hard-fought game. Not that I wish to admit your reasoning; but, as I have had the pleasure of playing over most of your brilliant games as they appeared in print, your game will show me your style of play different to what I have seen before."

My friend consented, and showed me one of his games, which I here reproduce, together with his remarks thereto:—

White M. W.	Black X.
1. P to K4.	P to K3.

I played the French Defence because my opponent was a very good player, and knew more of the Ruy Lopez than I did. In that case it is much safer to adopt the French Defence, it being easier to handle than the Spanish.

2. P to Q4.	P to Q4.
3. Kt to QB3.	Kt to K B3.
4. B to K Kt5.	B to K2.
5. P to K5.	

I am not at all satisfied that P—K5 cannot be played with advantage against the French Defence, either on the second-third move or as in this game.

5.	K Kt—Q2.
6 B × B.	Q × B.
7. Q Q2.	

Preparing himself for a long struggle, White wants to support his centre by playing his Kt to Q sq and K3—undoubtedly a good position.

7.	P to QR3

I intend advancing on the Q side, beginning with P to QB4. I must, however, play P to QR3 first; for if 7. P to QB4, 8. Kt to Kt5, followed by posting his Kt on Q6.

8. Kt to Q sq	P to QB4
9. P to QB3	P to B5

It is often injudicious to advance this P too early, as sometimes P to Q Kt3 threatens a break-up on the Q side, especially before the QBP has been moved. Another danger is on the K side from the KBP, which, if sufficiently supported, might attack the centre Pawns *viâ* KB5. An isolated KP or QP would then become a source of weakness.

10. P to B4	P to Q Kt4
11. Kt to B3	B to Kt2

A vague move. To meet a possible advance of the White KBP later on, the B must remain on B sq.

12. Kt to K3	Kt to QB3
13. B to K2	Castles KR

White already threatens P to B5, but in that case I should now play P to B3, which is the only way to meet this move, although, as before said, the Black QP would become isolated after BP × KP.

14. Castles KR	P to B4

I wanted to get rid of the danger arising from P to B5.

15. P × P, (*en pass*)	Kt × BP

This weakens my game, but on the whole I thought it better than P × P.

16. Kt to K5	Kt to K3
17. Q to B2	P to Kt5

I must utilise my advance on the Q side to weaken his Pawns there, as against my weak KP.

18. P to QR3	P × BP

I did not see any good in advancing P to Kt6. I cannot attack his QKtP, and the Black position would give White more freedom of action on the K side.

19.	P × P	Kt to R4

I made up my mind that the unsupported QBP or QRP should be the objects of my attack.

20.	P to KKt3	

White wishes to displace the Kt, and protects the KBP before playing B to B3.

20.		Kt to Kt6
	(See diagram No. 1.)	
21.	R to R2	QR to B sq.
22.	B to B3	Kt to Q3

I thought it best to retain my Kt to attack the P's *viâ* Kt4. If 22. Kt (Kt6) to Q7, then White plays 23. B × Kt, and I cannot play Kt × R, on account of 24. B × P (ch)!

23.	P to QR4	Q to K sq.
24.	B to Kt2	P to Kt3

I must prevent P to B5.

25.	Q to K2	R to QB2

I make the R available to protect the K, in case of an advance of P's on the K's side.

26.	R to K sq.	

White wants to displace the Kt by Kt to B sq. and Kt to Q2,

26.		R to KKt2

an unnecessary move. Black would only weaken his position by playing P to Kt4.

27.	Kt to Bsq	B to Bsq
28.	Kt to Q2	Kt × Kt

White could always force the exchange by R to Kt sq. I could not retake with the P.

29.	Q × Kt	R to Kt2
30.	Q to QB2	

DIAGRAM NO. 1.

WHITE.

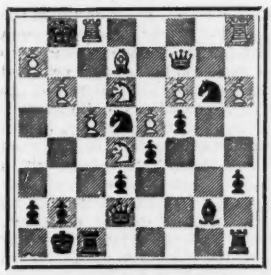

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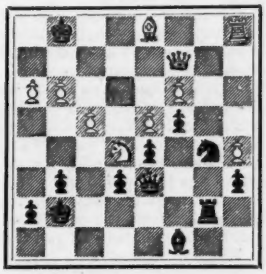
DIAGRAM NO. 2.

WHITE.



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This game is played with a steadfast purpose by both sides, White operating against the K's side, whilst Black pursues his advantage on the Queen side. Every move is the result of deep thought. White now has Kt to KtP in view for a future contingency.

		Kt to B2
31.	Kt to Kt4	Q to Q sq
32.	P to R5	R to Kt4
33.	KR to R sq	Kt to Q3
34.	Kt to K5	Q to B2

To avoid giving White a chance for a draw by Kt × KtP; also to prevent Kt × B6 and Kt to QKt4.

35.	R to Kt sq.	

An excellent move, as it disposes of the R. If now R × P, 36. R × R, Q × R. 37. Kt × P.

35.		K to Kt2

To stop Kt × P

36.	R × R	Kt × R
37.	P to R3	Q to Q3
38.	R to R sq.	R to K sq.
39.	B to B3	

My opponent strained every nerve to gain an advantage. He had formed the far-reaching plan of placing his B on QB2, from where he would be available for attack on the KKtP, assisted by the KRP. The B would also prevent my occupying the sq. on QKt6.

39.		R to K2
40.	B to Q sq.	R to Kt2
	(See Diagram No. 2.)	
41.	Q to Bsq	Q to B2

My intention was to attack the RP threefold by Kt to Q3, R to Kt4, and Kt to Kt2.

42.	P to R4	Kt to Q3
43.	B to B2	B to Q2

I deemed it prudent to bring the B in support of my KKtP.

44.	Q to R3	B to Ksq

I cannot, of course, move my Kt without moving the B.

45.	R to Ktsq	R × R (ch.)
46.	B × R	Kt to Kt2

You will see presently the depth of White's play. Beginning with 44. Q to R3, he induced me to play for the RP, because at last he saw his chance to get at my KP in a roundabout fashion. His idea was as deep as it was correct, and played with analytical profundity.

47.	B to B2	Kt × P.

At last my arduous efforts after the P succeeded, but so far from the game being decided, the real struggle only began after this, leading to a most interesting ending.

48.	B to Q sq.	

Now I was in a fix. I could not withdraw the Kt without losing the RP; I could not play Q to Kt3 on account of Q to K7; and, finally, B to Kt4 was threatened by White. In this difficulty I determined to give up two Pawns, force the exchange of Queens, and make a bold advance with the QRP. It was hardly sound play, but it succeeded in extricating me from my difficulties. (See Diagram No. 3.)

DIAGRAM NO. 3.

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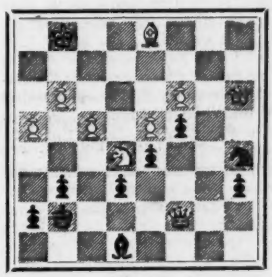

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DIAGRAM NO. 4.

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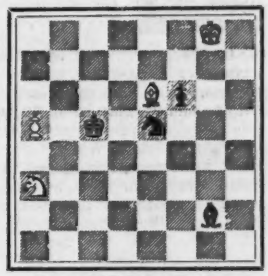

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48.		B to Kt 4
49.	B to Kt4	Kt to Kt2

You see I have the courage of my opinions.

50.	B × P	Q to Q3
51.	Q × Q	Kt × Q
52.	K to Bsq	

Another way of playing would be B × P followed by Kt to B3, Ksq, and B2. The following would have formed a neat catch:—

52. B × P, P to R4. 53. B to B6, P to R5, and wins.

52.		P to R4
53.	K to Ksq	P to R5
54.	K to Qsq	Kt to K5
55.	K to B2	P to R6

I was in no hurry to take off the KtP, as I could not afford to let White take my two P's and have two united passed Pawns. I was playing to get the QBP.

56.	B × P	Kt to Q7!

the adventurous and bold Knight

57.	B to B6	B to R3
58.	Kt to B3	P to R7
59.	K to Kt2	Kt to Kt8
60.	K × P	Kt × P (ch)
61.	K to Kt2	Kt to K7
62.	B to K4	

This is weaker than P to K5, which I believe might have been done before.

		Kt × KtP
63.	B to B2	Kt to K7
64.	P to B5	P × P
65.	B × P	P to B6 (ch)

I fondly hoped White would play K to B2, in which case B to Kt2 would win a piece.

66.	K to Kt sq.	B to Kt2
67.	Kt to Kt5	P to R3
68.	Kt to R3	

White could also play 68. Kt to K6(ch), K to B3. 69. B to Q3.

68.		Kt × P
69.	B to Q3	

It is White's intention to draw the game by playing Kt to B2 and K4. To prevent this I made a last effort.

69.		K to B 3
70.	Kt to B2	K to K4!

I ran every possible risk in this game in the vain effort to avoid a draw.

71.	Kt to Kt4 (ch).	K to B5.
72.	Kt × P.	(See Diagram No. 4.)

I now played B to Q4, with the idea of going to K3, whereupon

White played the ingenious move of 73. Kt to B5, and the game was drawn, as I cannot save the P. I am, however, not quite satisfied whether the game is really a draw, although I believe so. Black, however, could continue with either B to Bsq., or K to K6, or B to K5. These lines of play lead to some interesting variations, which I must leave you to examine for yourself.

Our Whist Column.

ON DISCARDING.

By Mogul.

THE essential principle of discarding, viz.—to discard the card least likely to be of use,—is so palpable that I can only wonder that in these latter days an attempt should have been made to ignore it altogether and propose therefore to consider the play which necessarily follows from an adherence to this principle and to comment on that which has been suggested in total disregard of it.

It requires but little experience to know that cards which may be of use if we hold the long trumps or even a certain card of re-entry, may be of no use at all under other circumstances, whilst other cards may be of little value if we hold winning trumps, but of great value if we are weak; hence arose the general rule given in Mathews (whose treatise still is, after Clay's, the most improving book on Whist for the advanced player) as follows: "If weak in trumps, keep guard on your adversaries' suits; if strong, throw away from them, and discard as much as possible from your partner's strong suit in either case." Now this is a good general rule, but, like other general rules, is too short to embrace all cases, and, in fact, there are so many contingencies affecting the discard that I doubt whether any sufficiently general reliable rule can be framed, and my advice to players is to keep the principle above stated ever before them and apply it in each case to the best of their judgment. If the strength of trumps is clearly on a player's side and he has a good strong suit, he will, of course, discard from his weak suit; but if the strength of trumps is clearly against him and his main object is to save the game, he will, equally of course, protect his weak suits, such as King or Queen and one or two others, and Knave, or even Ten, with three others, by discarding from his other suit, however strong or weak it may be. The chief difficulties in discarding arise when the strength of trumps on either side is not pronounced or when successive discards have to be made, and either weak suits must be unguarded or winning cards thrown away. In all these cases every player must rely on his own judgment. Having regard to the score, &c., sometimes a winning card must be retained to prevent the adversaries making others in the suit. Sometimes it must be discarded in order to keep guards on other cards; sometimes a losing card must be retained to lead to your partner holding the best and others or to put the lead in the hand of an adversary (this only in emergencies), and so on; in fact, the reasons *pro* and *con* for certain discards are often so well balanced as to make the proper discard in such cases as puzzling a matter as any in Whist.

With these views I regard Cavendish's dictum in his treatise, "When trumps are declared against you, your partner will give you credit for strength in the suit from which you originally threw away," as terribly misleading, and so does every fine player whom I have yet consulted. It assumes, in the first place, that you have a strong suit from which to discard, a most dangerous assumption to make when the game is in danger, and one very likely to destroy the only chance of saving the game, for because on the assumption that you are strong in the suit your partner would be justified in leading King or Queen, holding with it one or two small ones; and, if you are not strong, will sacrifice his honour uselessly; or, should he be induced by your discard to open a suit in which he holds nothing, the chances against your holding two honours are so considerable that, in all probability, the lead will suit the adversaries more than yourself. The dictum further assumes that you invariably want to be led to in the suit discarded from, but this very frequently will not be the case; *e.g.*, one of the safest and best discards when you want to save the game is from an Ace and two or three small ones, and yet you would much object to having the Ace taken out of your hand unless your partner has strength in the suit Take a case. When you hold Knave, Ten, and two others of one suit, and Ace and two small ones of another, the strength in trumps being with the adversaries and the game in danger, the proper discard is from the Ace suit; but the most advantageous lead for your partner to make, so far as your own hand is concerned, is the other suit; or, perhaps, holding Queen and two small ones in one suit, Knave and three small ones in another and two small cards in a third suit not yet opened, the proper discard is from the last. And yet it would be very awkward if your partner should jump to the conclusion that you wanted him to lead the suit. But Cavendish, with that love for rigid rules and uniform play which seems more and more to pervert his judgment, has lately pushed his views still further, and in his criticism on Proctor's treatise, "How to Play Whist?" has gone so far as to state, "that the discard from strong suits is as much a 'signal' as the call for trumps." His meaning here is certainly not very clear, for how, unless the Ace be discarded, his partner is to tell that it is a discard from a strong suit he does not explain; but, having regard to his above-quoted dictum, I suppose he means, and can only mean, a discard when the strength of trumps is adverse, and that such a discard is a command to his partner to lead that suit, and yet how foolish such a signal would be! For only consider that a discard is *always* forced play. We cannot refuse to make one merely because we have no strong suit. No one is ever obliged to make any other signal, but a player is compelled to discard, whatever his cards may be, and thus, according to Cavendish, to command his partner to lead the suit discarded from; but when one considers the innumerable hands that may be held in which we would prefer our partner not to lead the suit discarded from, and yet dare not discard from the suit we would like him to lead, as doing so would uncover the only card we could hope to make in it, does not Cavendish's theory appear thoroughly suicidal? It certainly does so to me, and all the more so when I reflect that when the adversaries have the strength in trumps they, and not your partner, will generally have the lead after your discard and will certainly avoid leading either of the suits which, if the discard be a signal, you or your partner have shown by your discards that you want led. Cavendish's signal would therefore guide your adversaries into the winning path and be worse than suicidal, inasmuch as your partner would suffer with yourself.

It would seem to me, and in this view I am supported by all the fine players with whom I have discussed the point, that you cannot regard a partner's discard, when trumps are adverse, as expressing any wish, much less any command, that you should lead that suit, and that you are bound, in the absence of any other indication than the discard of a small card (for if Ace be discarded it is quite another thing), to lead the suit which suits your own hand best—*e.g.*, to lead from a suit of four with two honours or any stronger suit, or even from a suit headed with Knave or Ten, rather than open a suit in which you hold absolutely nothing; but, if you have no suit you can open without palpable disadvantage, you had better, in such an emergency, lead the suit from which your partner has discarded, not because he has told you he is strong in it or has shown he wants it led; but because, as a general rule, the suit, from which he can discard with the least risk, will be his strongest suit. In such a case, I would lead Knave, and probably Queen, holding with either, two small ones; but I most assuredly should not so far rely on my partner holding strength in the suit as to lead King from King and two small ones; or, indeed, with King and one other to open the suit at all.

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Knowledge October Numbers (205, 206, and 207) have not been included in any monthly part, but form part of Vol. VIII., the last number containing the index to the Volume. These three numbers can be obtained either through an agent or direct from the Publisher, price 3d each, post-free.

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